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N.W. BERNSTEIN & ASSOCIATES

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August 27, 1997

By Federal Express

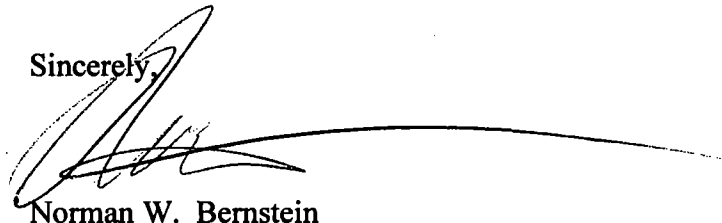
Mr. Mike McAteer
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard, HSR-6J
Chicago, IL 60604

Re: Enviro-Chem (ECC) Site, Zionsville, Indiana

Dear Mike:

Pursuant to our discussion at the August 14, 1997 meeting, enclosed please find Exhibit A, May 7, 1997, Revision 2. I have also sent a copy to the Jim Freeman at the Department of Justice. A copy of my letter to Jim is also enclosed.

Sincerely,



Norman W. Bernstein

Enclosures

cc: Tom Krueger
Vince Epps (IDEM)
Tim Harrison (CH2M Hill)

REVISED EXHIBIT A

MAY 7, 1997

REVISION 2

N.W. BERNSTEIN & ASSOCIATES

2000 M STREET, N.W., SUITE 745 • WASHINGTON, D.C. 20036 • (202) 466-8100 • FAX: (202) 466-8877

August 27, 1997

James Freeman, Esq.
United States Department of Justice
Environment & Natural Resources Division
Environmental Enforcement Section
1425 New York Avenue, N.W., Room 13073
Washington, D.C. 20005

Re: *United States v. ECC et al.*, Cause #IP83-1419-C-M/S

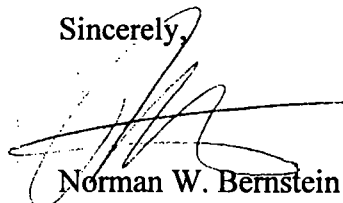
Dear Jim:

As you have probably been informed, the Trustees and EPA had a highly successful meeting on August 14, 1997. EPA and IDEM thereafter both provided their "conceptual level concurrence" in the proposed SVE design for the site. Pursuant to those discussions, enclosed please find Revised Exhibit A, May 7, 1997, Revision 2. At Mike McAteer's suggestion and with Tom Kruger's concurrence, we are providing it to you at the same time that we are providing it to them and to IDEM.

As far as I can tell, the only changes that will need to be made to the documents previously provided are: (a) footnote 1 to the Stipulation and Joint Motion will need to be changed to refer to "Revision 2" rather than "Revision 1" and (b) paragraph 5 of the Order will need to be similarly changed.

If you have any questions, please do not hesitate to call me.

Sincerely,



Norman W. Bernstein

Enclosure

cc: Mike McAteer
Tom Krueger
Vincent Epps (IDEM)

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EXHIBIT A

1.0 INTRODUCTION

This document is a plan to carry out the Revised Remedial Action (hereafter, "Revised Remedial Action," "RRA," "Exhibit A," or the "Document") and describes the work to be performed by the Settling Defendants at the Environmental Conservation and Chemical Corporation ("ECC") Superfund site as required by the attached Consent Decree ("Consent Decree" or "Decree"). This document is attached as Exhibit A to (and is incorporated by reference into and made an enforceable part of) that Decree, as amended.

The purpose of this Exhibit A is to set forth those remedial activities to be performed at the ECC site. The Settling Defendants under the Consent Decree (hereafter "Settling Defendants") shall arrange to have the work required hereunder performed by a Contractor or Contractors ("Contractor") in accordance with the requirements and specifications set forth herein.

The components of the RRA as presented herein are compatible with the proposed remedy for the adjacent Northside Sanitary Landfill (NSL) site. The ECC RRA and the existing NSL Design will be reviewed to ensure compatibility of design and construction schedules for each system. If any inconsistencies are identified, the Settling Defendants (through the ECC Trustees) shall consult with those performing the remedy at NSL, and with the U.S. Environmental Protection Agency (USEPA) and the State to attempt to resolve any such inconsistencies.

2.0 REVISED REMEDIAL ACTION

2.1 Elements of the RRA

The major elements of the RRA are: (1) excavation of the southern portion of the site; (2) placement of the excavated material over the northern portion of the site; (3) soil vapor extraction (SVE) of the soil and excavated material on the northern portion of the site, followed by concentration, and destruction of the organic vapors; (4) Resource Conservation and Recovery Act (RCRA)-Compliant (Subtitle C) Cover; (5) access restrictions; and (6) subsurface and surface water monitoring.

The original ECC Remedial Action Plan was to provide soil vapor extraction (SVE) via horizontal trenches beneath a multilayer cap over the entire area within the remedial boundary. However, during the Site Preparation and Material Removal (SPMR) and the design phase of the project, several engineering and operational modifications were developed. The modifications are intended to: (1) effectively remediate the soils at the

southern portion of the site, (2) utilize a more flexible, performance-based SVE design for soliciting contractor bids to take advantage of contractor expertise, with a "second look" review and approval of the selected contractor's completed SVE design by USEPA and the Indiana Department of Environmental Management (IDEM), and (3) incorporate treatment of contaminated soils outside of the original remedial boundary. A summary of key elements of the RRA are as follows:

- Excavation of the Concrete Pad Area at the southern end of the ECC site to a depth of 9 feet below ground surface (BGS) plus any remaining contamination identified by visual inspection or field screening to the extent safe and practicable and placement of the crushed concrete pad, subbase aggregate, and soil in segregated treatment zones on the northern portion of the site for vapor extraction.
- Temporary placement of sheet piling in the eastern portion of the excavation area to control infiltration during excavation.
- Collection, treatment as needed, and discharge of any water that collects in the excavation.
- Vapor extraction of the northern two-thirds (approximately) of the ECC site, including the use of SVE trenches and/or wells for effective remediation of vertical intervals with differing permeabilities and increased flexibility to modify the extraction layout as needed.
- Participation of SVE Contractors in the SVE design by using a performance-based specification (providing treatment objectives and criteria) with a "second look" review and approval by USEPA prior to implementation of the RRA.
- Positive control (collection and removal) of subsurface till water¹ encountered in the zone of treatment by providing sufficient vacuum and/or supplemental air to remove water which accumulates in the extraction wells and/or trenches.
- Maximizing the flexibility of SVE implementation by staging the placement of the RCRA-Compliant final cover. Stage 1 will consist of an SVE surface seal (3 feet of impermeable

¹ For purposes of this document, "subsurface" water shall mean "ground water," as defined in 40 CFR 260.10.

native soil and 1 foot of top soil) installed prior to SVE operation. Stage 2 will consist of a geocomposite drainage net with a minimum of 1 foot of soil fill and 1 foot of topsoil (which may be the same topsoil from the Stage 1 cover stripped and replaced during construction of Stage 2) and will be installed after completion of SVE operations.

- Relocation of the central portion of the western remedial boundary as shown on Figure 2-1.

2.1.1 Excavation of the Southern Portion of the Site (the Concrete Pad Area)

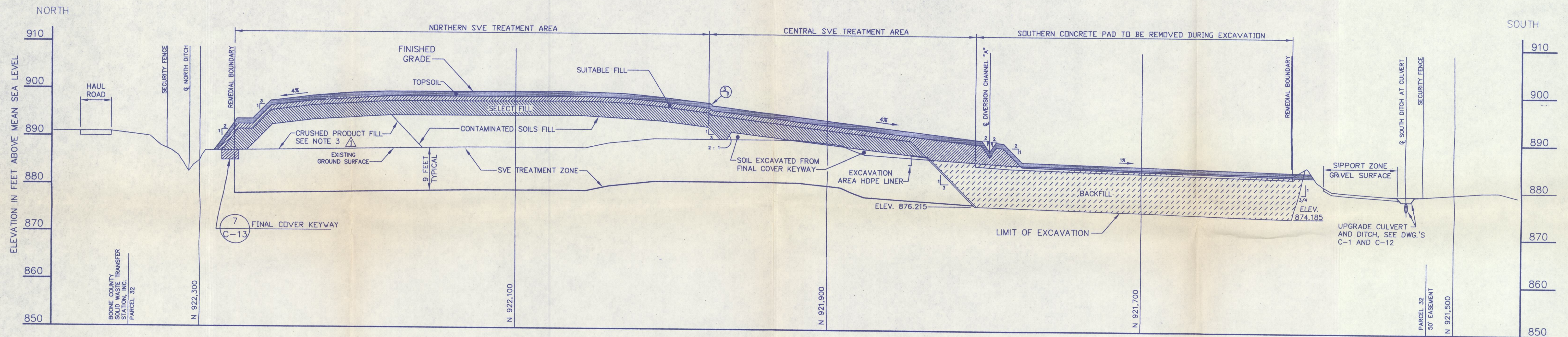
The objective of the excavation activity is to remove contaminated concrete, subbase, and soil from the Concrete Pad Area, and to spread the excavated material over the northern portion of the site to be vapor extracted, as described in Section 2.1.2. The concrete will be crushed to a maximum particle size of 3 inches, and will be placed along with the crushed concrete from the former building slabs in the northern area and the concrete subbase in a segregated layer as shown on Figure 2-2.

The soil in the Concrete Pad Area will be excavated to a depth of 9 feet (or further as described below), as measured from the top of the concrete pad. This removal and backfill with native soils ensures a level of cleanup in the southern portion of the site greater than or equal to the originally proposed SVE for the Concrete Pad Area. The eastern portion of the Concrete Pad Area may require sheet-piling to control infiltration from the underlying sand water-bearing zone. All water collected in the excavation will be treated and discharged on-site in accordance with the substantive requirements of applicable federal and state laws unless during the excavation the water treatment system is shut down and water accumulates in the water collection system in excess of storage capacity, then additional waters generated during the excavation will be disposed of off-site in accordance with all requirements of federal and state laws and regulations. The off-site water disposal will terminate as soon as practicable once the on-site treatment system operation and storage capacity allows for resuming on-site water management. Excavation dewatering may be required as follows:

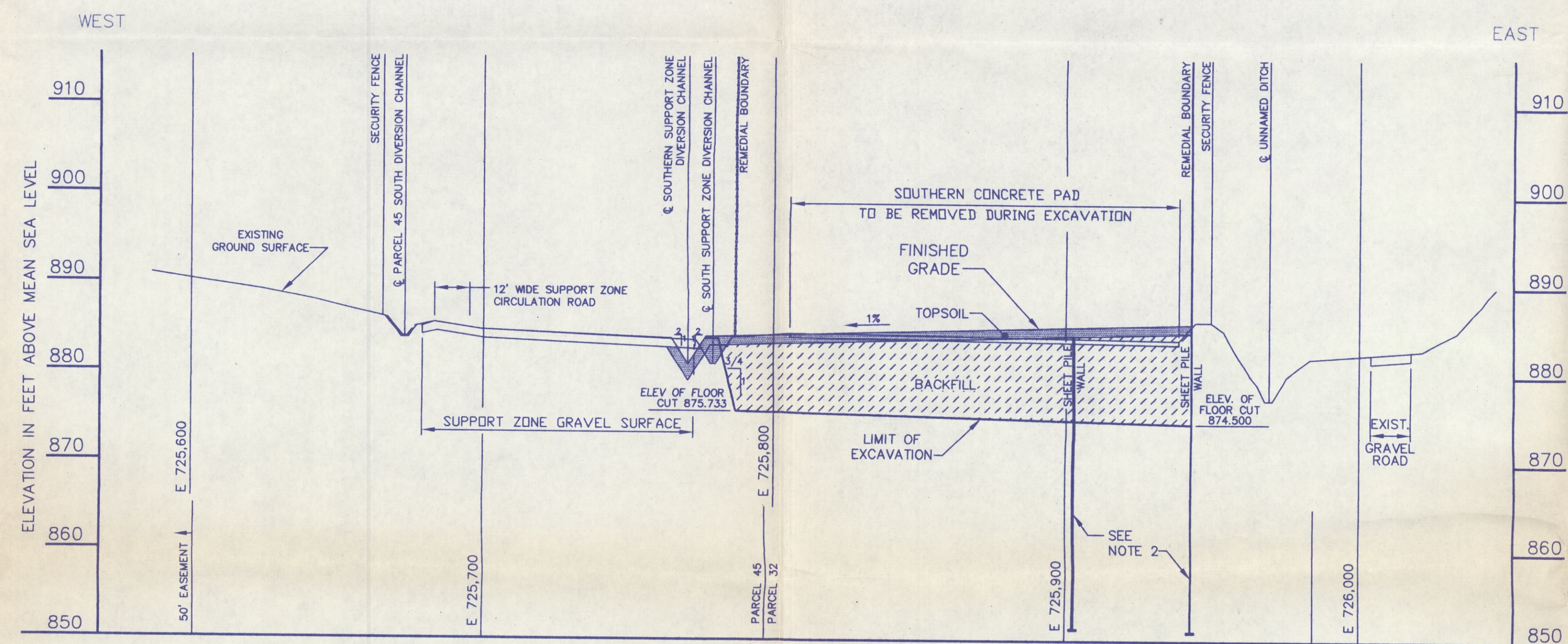
1. Open pumping in the concrete pad subbase by means of sump pumps;
2. Predrainage dewatering of the sand water-bearing zone within the sheetpile cutoff wall (prior to excavation) by means of well points;
3. Dewatering of the sand water-bearing zone during excavation inside the sheetpile cutoff wall, and until backfill

FIGURE 2-1

FIGURE 2-2



SITE CROSS SECTION AT E 725,860 (SEE NOTE 1)
LOOKING EAST



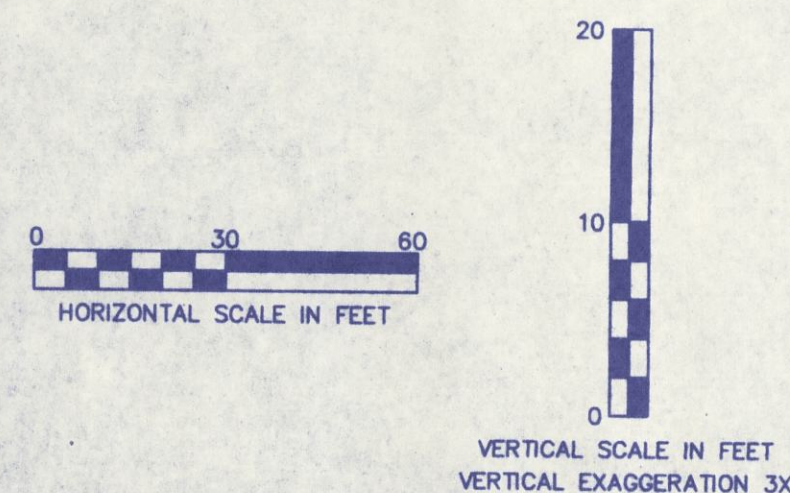
SITE CROSS SECTION AT N 921,700 (SEE NOTE 1)
LOOKING NORTH

NOTES:

- CROSS SECTION LOCATIONS ARE SHOWN ON DRAWINGS G-2, AND C-1 THROUGH C-7.
- THE SHEET PILE CUTOFF WALL DEPTH SHALL BE A MINIMUM OF 24 FEET BELOW THE FLOOR ELEVATION OF THE EXCAVATION. THE SHEET PILE CUTOFF WALL SHALL BE EXTENDED THROUGH AND TO THE BASE OF THE UNDERLYING SAND WATER-BEARING ZONE IN ORDER TO REDUCE EXCAVATION DEWATERING VOLUMES. ADDITIONAL FIELD SUBSURFACE INVESTIGATIONS TO BE CONDUCTED BY THE CONTRACTOR IN ACCORDANCE WITH THE SPECIFICATIONS MAY RESULT IN MODIFICATIONS TO THE EXCAVATION DEPTH AND SHEET PILE CUTOFF WALL ALIGNMENT AND DEPTH.

3. THE CRUSHED PRODUCT AREA SHOWN IS APPROXIMATE IN DIMENSION. ALL CRUSHED CONCRETE AND SUB-BASE MATERIAL NOT USED IN THE SVE TRENCHES WILL BE PLACED IN THIS AREA.

FIGURE 2-2
SITE CROSS SECTIONS
ENVIRO - CHEM SITE
ZIONSVILLE, INDIANA



of at least 3 feet of compacted soil fill, by means of wellpoints; and

4. Open pumping of seepage water and rainwater from the excavation, by means of sump pumps.

The ECC sump, located at the southeastern corner of the Concrete Pad Area, is understood to be a 20-foot square, 12-foot-deep pit that has been backfilled with gravel-sized aggregate. The lower portions of the ECC sump will be sealed by using pressure-injection cement-based grouting prior to excavating the concrete pad and subsoils. Well No. ECC MW-12, located within the sump, will be abandoned as part of the grouting.

Surface water will be rerouted in the Concrete Pad Area to reduce the infiltration of precipitation into the excavation. A synthetic membrane and drainage layer will be constructed between the Concrete Pad Area excavation and the northern two-thirds of the site to minimize any migration of contaminated subsurface water and vapor into the clean native clays soils to be placed in the Concrete Pad Area excavation.

The excavation will be available for sampling by USEPA and/or IDEM. To minimize the water management issues, all areas excavated to the 9-foot limit (or further as described below) will be backfilled with clean, native clay soil within one working day. At the conclusion of the excavation USEPA and IDEM will conduct exit soil sampling before backfilling but shall do so promptly as to avoid delaying the backfill operations. The results of the exit sampling, when obtained, will affect whether and the extent to which a RCRA-Compliant (Subtitle C) cover may be required over some or all of the backfilled area but will not affect or delay backfilling. Before excavation begins, an independent Indiana-registered engineer specializing in geotechnical engineering will provide a written determination of the maximum safe depth for excavation in the Concrete Pad Area for review and concurrence by USEPA and IDEM. Any contamination identified by visual inspection remaining at the 9-foot level will also be excavated, but any such excavation will not exceed the maximum safe depth determined in accordance with the foregoing. In addition, after excavation to the 9-foot level, field readings will be taken. If there is agreement among the representative of the ECC Trustees, the USEPA's Project Manager, and the State Project Coordinator, then additional excavation will be undertaken based on the results of field instrumentation, provided also that the excavation is deemed safe and practicable in accordance with the foregoing. The area or areas, if any, where residual contamination both remains above RCRA clean closure criteria and cannot safely and practicably be removed from the Concrete Pad Area, will be addressed by a RCRA-Compliant cover over such area. Any cover or covers placed over the excavated area or areas will be continuous with the RCRA-Compliant (Subtitle C) cover described in Section 2.1.3. Sidewall sampling data and supplemental excavation, if any, or additional RCRA-Compliant (Subtitle C) cover(s) resulting from the sidewall sampling data shall conform to the Sidewall Soil Sampling Protocol attached as Appendix F to this Revised Exhibit A. After completion

of the excavation and backfilling, 12-inch layer of topsoil will be placed over the clean, native clay backfill and the area will be vegetated.

2.1.2 Soil Vapor Extraction, Concentration, and Destruction

The objective of the SVE activity is to remove and destroy volatile organic compounds (VOCs) and selected base neutral/acid organics (as provided herein) from both the soils north of the Concrete Pad Area within the Revised Remedial Boundary and the crushed concrete/soil fill from the southern portion of the site placed on top of the *in situ* soils (the vapor extraction area).

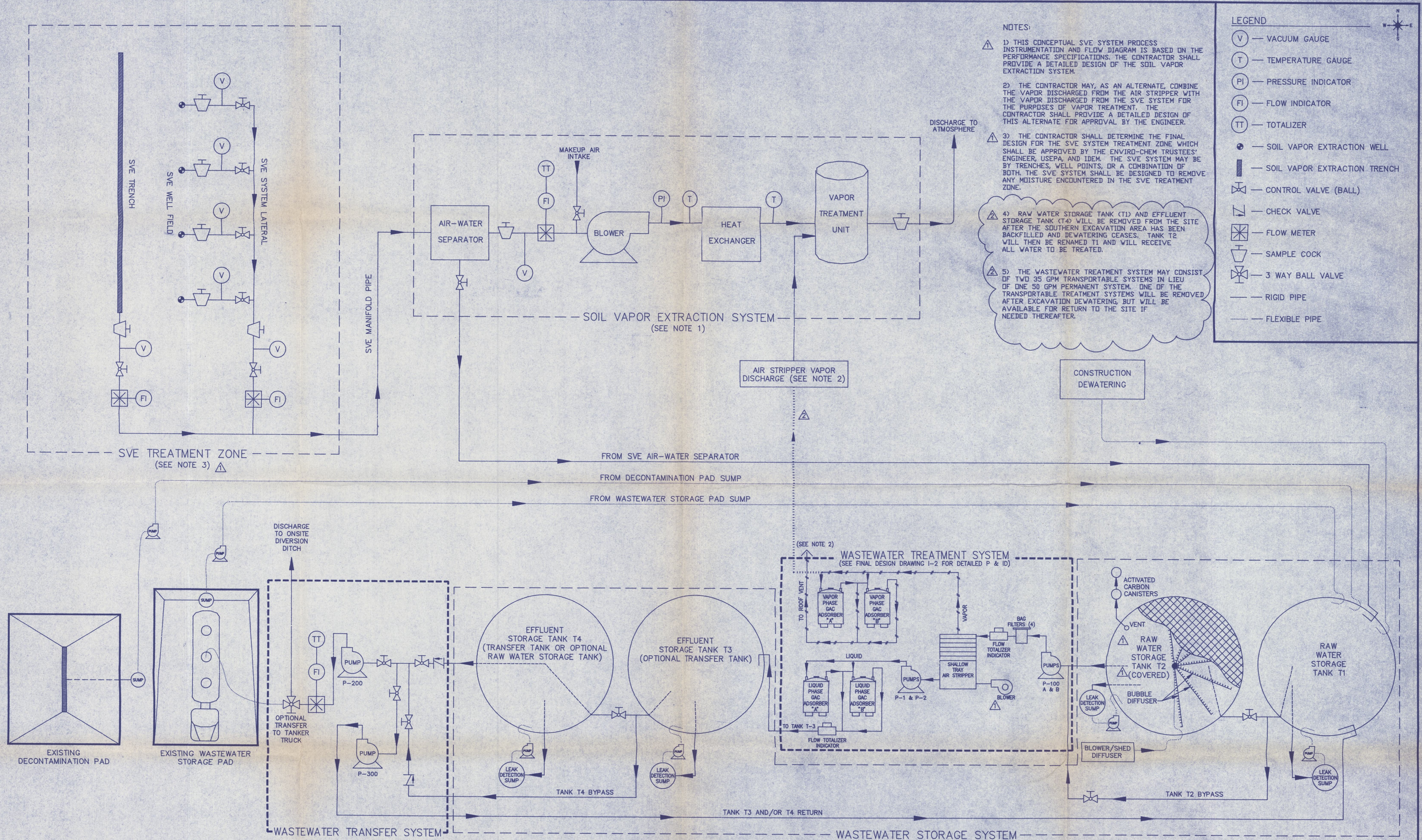
By systematically moving air through the zone of contamination, volatilization and hence removal of organics are accelerated. Air movement through the soil will be controlled by a network of wells and/or vertical trenches installed throughout the zone of contamination. The process also involves the continuous extraction of organics-laden air from the well and/or trench system and treatment of the air by activated carbon to remove the organics. The organics so collected will then be destroyed off-site during carbon regeneration in conformance with the substantive requirements of applicable federal and state laws.

The potential effectiveness of vapor extraction for organics removal from the ECC soils was demonstrated during a pilot test conducted by Terra Vac, an environmental consulting firm, in June 1988. The description of the pilot test, including the results obtained, was previously submitted to USEPA and the State of Indiana. The test showed an initial high organics extraction rate of 1.9 pounds per day per foot of trench that decreased over the course of the pilot test to a steady state rate of approximately 0.25 pounds per day per foot of trench.

The following discussion and drawings describe the conceptual design and operation of the modified SVE system.

The SVE process is illustrated in Figure 2-3. The basic operation consists of extraction of air using one or more vacuum pumps from a network of wells and/or trenches located throughout the vapor extraction area. Free liquid entrained in the air is removed by gravity in an entrainment separator. Periodically, water which accumulates in the entrainment separator is pumped to an on-site storage tank for subsequent treatment as needed, and then to on-site discharge in accordance with the substantive requirements of applicable federal and state laws. If the SVE system is shut down due to a combination of (a) the need to shut down the water treatment system and (b) exceedance of on-site water storage capacity, and the shutdown of the SVE system for that reason continues for more than 5 days in any one month or for more than an average of 3 days a month (using a rolling average and for this purpose an assumed SVE operation time of 1 year), then water generated by the SVE system will be disposed of off-site so as to allow resumption of SVE system operation. Off-site water disposal, if any, will be performed in accordance with all requirements of federal and state laws

FIGURE 2-3



and regulations. Off-site water disposal will terminate as soon as practicable once the on-site treatment system operation and storage capacity allows for resuming on-site water management.

From the vacuum pump or pumps, air passes through the carbon adsorption system, which consists of carbon columns connected in series. Off gases from the carbon adsorption system may be withdrawn by a pump and reinjected into the network of injection wells and/or trenches located throughout the vapor extraction area. With or without injection, as the air migrates through the soil toward the extraction wells and/or trenches, the organics are vaporized into the air-stream. As described in Section 2.1.3, Stage 1 of the RCRA-Compliant (Subtitle C) Cover will be placed over the entire SVE network as a surface seal to reduce air and water infiltration into the system during operation.²

The major SVE system components are:

- Extraction and injection wells and/or trenches in the northern approximately two-thirds of the site,
- SVE system,
- An impervious synthetic membrane separating the areas to be vapor extracted and the clean, native clay Concrete Pad Area excavation backfill,
- Water collection system,
- Carbon adsorption system, and
- Stage 1 of the RCRA-Compliant (Subtitle C) Cover.

A description of the design and operational features of each of these components is presented below.

Extraction and Injection Trenches and/or Wells

The area where remedial activity will occur is depicted in Figure 2-1. During the SPMR, it was discovered that some limited additional contamination is present 6 to 8 feet BGS west of the remedial boundary in the Central Support Zone Area, and in surficial soils at the former ECC site entrance. The extent and degree of the contamination was

² As noted in Section 2.1.3, the RCRA-Compliant (Subtitle C) Cover may (or may not) be required to be placed over areas the backfilled southern portion of the site depending on whether exit sampling conducted by IDEM and USEPA shows exceedances of RCRA "clean closure" in the area (or areas).

delineated by the Central Support Zone Investigation (CSZI) performed by DEI, and resulted with relocation of a portion of the western boundary of the site to "Line D" the Central Support Zone Revised Remedial Boundary.

The SVE system will be designed to be effective to a minimum depth of 9 feet, as measured from existing grade. If trenches are employed, they will be designed to allow for injection and/or extraction. The bottom elevation for both injection and extraction trenches will be sloped at a minimum of one-sixteenth inch per foot to a low point to facilitate water collection. If wells are utilized, well design will incorporate vapor extraction and or injection and water removal.

Soil removed from the SVE installation will be spread over the surface of the northern approximately two-thirds of the site prior to construction of the first stage of the cover system and covered in accordance with the first stage RCRA-Compliant (Subtitle C) Cover detail (Figure 2-4). Soil and crushed concrete removed from the southern portion of the site (Concrete Pad Area) will be spread over the surface of the northern portion of the site along with SVE construction spoils and crushed concrete and subbase from the Concrete Pad Area will be placed in a segregated zone as shown on Figure 2-2.

SVE System

The 90% Design includes a performance-based specification for the SVE portion of the RRA. The SVE system will be designed by the successful 90% Design bidder. The design may be a system of SVE trenches, wells, or other SVE techniques or combination of techniques. Prior to the selection of the SVE successful bidder, the Trustees will conduct informal discussions with USEPA and IDEM to obtain their conceptual-level concurrence regarding the proposed approach for SVE system design. USEPA will have a "second look" opportunity to review and approve the final (100%) SVE Design (including the O&M plan for the SVE system) pursuant to the Consent Decree as amended, when that SVE Design is later submitted.

All areas within the remedial boundary except the Concrete Pad Area will be addressed by SVE. The SVE vacuum system will be capable of developing a minimum vacuum of 20 inches Hg. The normal operating vacuum will be established by the SVE contractor. The Terra Vac pilot test at the ECC site results showed an initial radius of influence of 15 feet during trench development. Under continuous operation, the radius of influence increased to about 20 feet. The enhanced operating efficiency obtained by installing the SVE Stage 1 cover should increase the radius of influence to over 20 feet. To be conservative, for purposes of the design, the radius of influence will be assumed to be 18 feet.

The design air volume (consistent with the Terra Vac pilot plant test results) criteria is to provide at least one air volume change per soil pore volume per day. Based on an estimated area of treatment of approximately 115,400 square feet, a depth of 9 feet, and

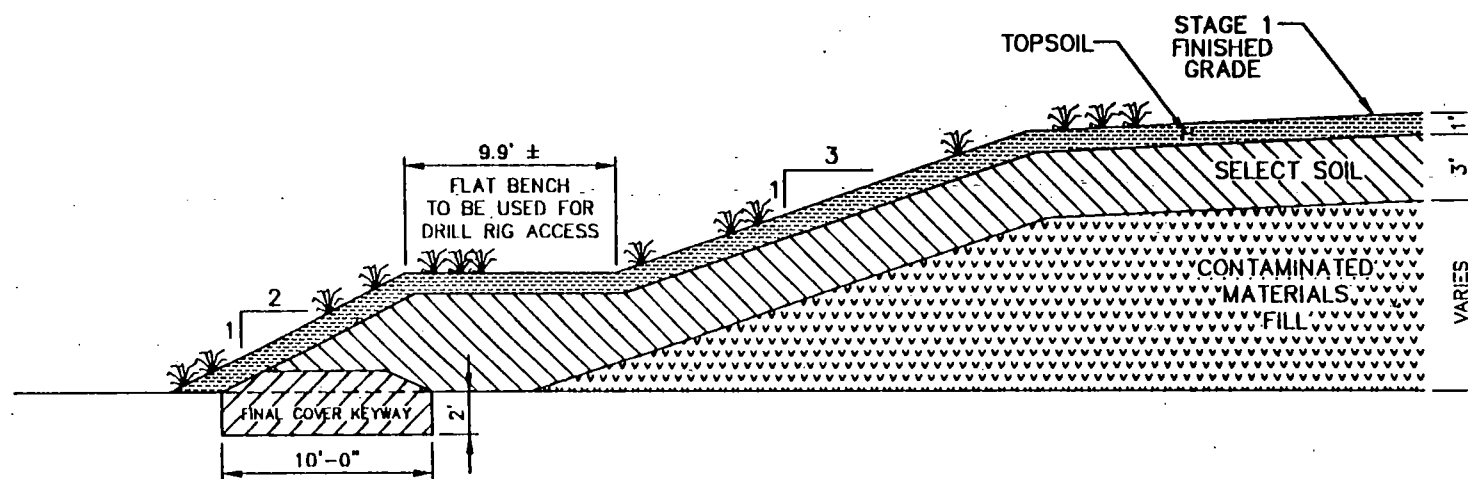


FIGURE 2-4

**STAGE 1 COVER DETAIL
ECC SITE
ZIONSVILLE, INDIANA**

NOT DRAWN TO SCALE

SOURCE: DOW ENVIRONMENTAL DRAWING C-13, REVISION 0, DATED 11/10/95.



an average soil porosity of 20%, 200 SCFM would be the minimum air flow that meets the design.

The vapor extraction process is intended to operate continuously. It will shut down automatically only in the event of an operating problem or malfunction. The following are conditions which will shut down normal operating sequence of the vapor extraction system:

- High vapor temperatures above the estimated acceptable range of 150°F to 180°F prior to activated carbon treatment,
- Low vapor temperatures below the estimated acceptable range of 75°F to 85°F prior to activated carbon treatment indicating relative humidity above the estimated acceptable range,
- High water level in water entrainment separator indicating operating problems with liquid transfer operation,
- High water level in water storage tank,
- High or low pressure conditions on vacuum or injection pumps under normal operating conditions, and
- Power interruptions at the site.

During normal operation, vapor extraction may be stopped to facilitate carbon vessel change out and during transfer of water from the entrainment separator to the on-site water storage tank, or to conduct restart spike tests.

The air extracted from the system will be continuously monitored by in-line instrumentation as shown on the general process and instrumentation diagram (Figure 2-3). The capability will exist to sample individual well and/or trench exhausts or the combined air stream. Sample taps also will be provided to collect vapor samples for detailed chemical analysis. At a minimum, the on-line instrumentation will include a PID and moisture analyzer. The vacuum pump, controls, and instrumentation will be protected from the elements.

As the clean-up standards set forth in Table 3-1 below are met for individual well and/or trench "areas," the corresponding extraction (and injection) points will be isolated from the extraction and injection operation by closing the shut-off valves located at each well and/or trench. This will permit the SVE system to concentrate on any remaining areas which have not fully achieved the clean-up standards specified in Table 3-1, thereby accelerating cleanup of those areas.

An impermeable, synthetic liner will be placed between the excavated Concrete Pad Area and northern area to be vapor extracted. The barrier will be placed promptly after the completion of the excavation and postexcavation soil sampling in each stage of the southern Concrete Pad Area excavation. The barrier will be designed to deter water from moving into the excavated area and reduce air infiltration into the area of SVE operation. The northern sidewall of the area of excavation will be covered by the barrier and shall be sloped uniformly, based on engineering analyses of barrier stability. A suitable anchor trench will be constructed at the top of the slope to anchor the barrier firmly in place during the backfilling process.

Water Collection System

The vacuum vapor extraction system selected will be capable of entrainment and movement of water which accumulates in the extraction wells and/or trenches. Any free liquid in the extracted vapor will be separated by gravity in an entrainment separator located with the SVE vacuum pumps. A level control system will be utilized to control the removal of water which accumulates in the entrainment separator as required. The separator tank will be equipped either with a vacuum breaker system which will open the tank to the atmosphere or a pump capable of removing the water from the separator while under vacuum to permit water to be transferred by pump from the separator to an on-site water storage tank as necessary. Controls and instrumentation will be protected from the elements. The time required to make the transfer to the separator will depend upon the equipment supplied by the vapor extraction system vendor selected.

The size of the storage tank will be sufficient to store the liquids for a period of time compatible with the selected water handling/treatment method. The tank will be equipped with level measurement and control to advise operating personnel to the status of liquid accumulation in the storage tank. Periodically, the contents of the water storage tank will be removed for treatment and discharged on-site in accordance with the substantive requirements of applicable federal and state laws or, if there is any off-site disposal, in accordance with all requirements of federal and state laws for off-site disposal, if any.

Carbon Adsorption System

The exhaust from the soil vapor vacuum pump system will be piped to a two-stage carbon adsorption system (primary and secondary). At a minimum, this system will consist of two vessels in series containing granular activated carbon. The organics contained in the extracted air will be adsorbed on the activated carbon. The moisture content of the air stream will be less than 50% relative humidity and temperatures will be maintained below 150° F by a cooling system, both acceptable for efficient operation of carbon adsorption.

During the initial phase of operation when organics concentrations in the airstream will be highest, the carbon capacity for the organics is expected to be about 25% by weight. Based on an assumed total mass of organics of about 2,164 pounds (Appendix A), the total quantity of activated carbon required for the entire remediation program is estimated to be 8,700 pounds. These are estimates only and the actual amount of carbon used will depend on the total mass of organics extracted during operation of the SVE system and the carbon adsorption capacity.

The vapor from the primary carbon vessel will be monitored frequently by an on-line organic analyzer. When the organic analyzer detects organic vapor in the airstream at 50 percent or greater of IDEM discharge limitation between the primary and secondary carbon vessels, the vacuum extraction system will shut down automatically to permit the removal and replacement of the "spent" primary carbon vessel. An operator will be alerted to this condition by the shut-down alarm, and will disconnect the primary carbon bed from service. The spent carbon vessel will be removed and replaced by a carbon vessel containing fresh activated carbon. The unit previously serving as the secondary carbon bed will become the primary carbon bed and the unit just placed in operation will be the secondary carbon bed. Once this switch is complete, the SVE system (i.e., vacuum pump and injection pump) will be restarted, and the system operation resumed. The arrangement of two activated carbon vessels in series (i.e., primary and secondary) will permit optimal utilization of the activated carbon, and efficient capture of the organics. The spent carbon vessels will be stored on-site. The vapor extraction equipment supply yard is shown in Figure 2-1, will be located in the support zone and to the extent appropriate, within the Revised Remedial Boundary. The inlet and outlet connections to each carbon vessel will be capped and sealed appropriately. Periodically when a truckload quantity of vessels has accumulated, and at the conclusion of the vacuum extraction program, the vessels containing the spent carbon will be transported in accordance with the requirements of the applicable federal and state laws to an off-site facility where the carbon will be regenerated by high temperature incineration, and in the process, the organics adsorbed on the carbon will be destroyed.

Air Injection System (Optional)

If air reinjection is utilized by the SVE system, the exhaust air from the secondary carbon bed will be piped to the injection pump. The injection pump will be capable of injecting air at pressures up to 10 pounds per square inch gauge (1.65 atmospheres). The discharge from the injection pump will be distributed to the injection wells and/or trenches via a system of manifolds. Control of the injection pump will be interlocked with the vacuum extraction pump. The pipe at each injection point will be equipped with a pressure/vacuum gauge so that injection pressure can be periodically monitored.

Injection manifold piping will allow for modifications and flow reversal.

RCRA-Compliant (Subtitle C) Cover

The operation of the vapor extraction system may be enhanced by the installation of the first stage of a two-stage RCRA-Compliant (Subtitle C) Cover over the area to be vapor extracted. The cover will also help reduce surface water infiltration, thus reducing any continued migration of contaminants. Details and a schedule for installation of both stages of the RCRA-Compliant (Subtitle C) Cover are presented in Section 2.1.2.

Miscellaneous

- Each extraction well and/or trench will be equipped with two sample taps, one on the vacuum pipe and one on the water collection pipe. Each of these taps can be fitted with a sample bottle for the collection of free moisture.
- Electrical service required for the site remediation work is anticipated to be three-phase 460-volt. Total electrical demand will be approximately 100 kilovolt-ampere (kVA). Power distribution will be to the SVE pumps, controls, and instrumentation. Operating voltage for the SVE system is anticipated to be 460 volts. A 110-volt supply will be provided for miscellaneous site lighting, equipment, instrumentation, and controls. Power distribution to any site construction and office trailers will also be provided.
- Prior to construction of the SVE system, the following activities were conducted as part of the Site Preparation and Material Removal Phase during spring 1994 and the drum removal operations in 1995 and early 1996;
 1. The existing buildings within the remedial boundary were demolished and properly disposed of off-site;
 2. The existing tanks, drums, and debris within the remedial boundary were removed and properly disposed of off-site;
 3. The site has been graded to fill existing depressions and to eliminate any sharp grade changes;
 4. A remedial boundary fence and drainage system was constructed; and

5. An operational boundary (remedial area plus support zone area) fence and drainage system was constructed.

2.1.3 RCRA-Compliant (Subtitle C) Cover

The RCRA-Compliant (Subtitle C) Cover will be constructed in two stages as presented on Figures 2-4 and 2-5. The first stage will consist of a minimum of 3 feet compacted, impermeable native soil and 1 foot of top soil to support vegetation (Figure 2-4). The second stage will be the addition of a geotextile/geomat layer and 1 foot of native soil below the stripped and replaced top soil. The final grading plan will ensure a minimum slope of 3%. The native soil used will be the silty clay till available in the area, which can and will be compacted by standard methods to 95% Proctor density. If soil from the neighboring NSL Facility borrow area is not available, material with similar performance will be obtained by Settling Defendants from another source.

To provide a perimeter seal of the Stage 1 cover, a 10-foot-wide, 3-foot-deep "key" will be installed around the site boundary (Figures 2-4 and 2-5). The Stage 1 cover will be continuous with the key. The Stage 1 and 2 covers will extend approximately 6 feet beyond the key.

The RCRA-Compliant (Subtitle C) Cover Stage 1 cover will be installed over the vapor extraction area within the remedial boundary. If exit sampling is conducted in the Concrete Pad Area by USEPA and IDEM and if the results of such sampling exceed RCRA "clean closure" values, the cover will also be placed over the portion of the excavated area where contamination remains above "clean closure". If the cover is either over the entire excavated area or a portion of the excavated area, the cover over the excavated area or portion of the excavated area will be physically connected to and be an extension of the cover over the SVE area.

Prior to operation of the SVE system, the following components of the RCRA-Compliant (Subtitle C) Cover will be installed: (1) 3 foot minimum compacted native soil, and (2) 1 foot of topsoil to support vegetation. The remaining components (geonet with geotextile and 1-foot minimum native soil under the stripped and replaced topsoil, and appropriate vegetation) will be installed after completion of the SVE system operation in accordance with Schedule Z. The Stage 2 cover will satisfy RCRA cap performance standards, including minimizing migration of liquids, promoting drainage, minimizing erosion, accommodating settling and subsidence, and having permeability less than or equal to 10^{-6} cm/s. Also after completion of the SVE program, all surface piping will be removed from the site in addition to any equipment, buildings, or trailers. At that time the extraction and injection piping may be cut off at the current grade, filled with grout, covered with a minimum of 1 foot of topsoil, and vegetated. The SVE system will be abandoned in accordance with substantive federal and state requirements. Vegetation which will be established shall include fibrous,

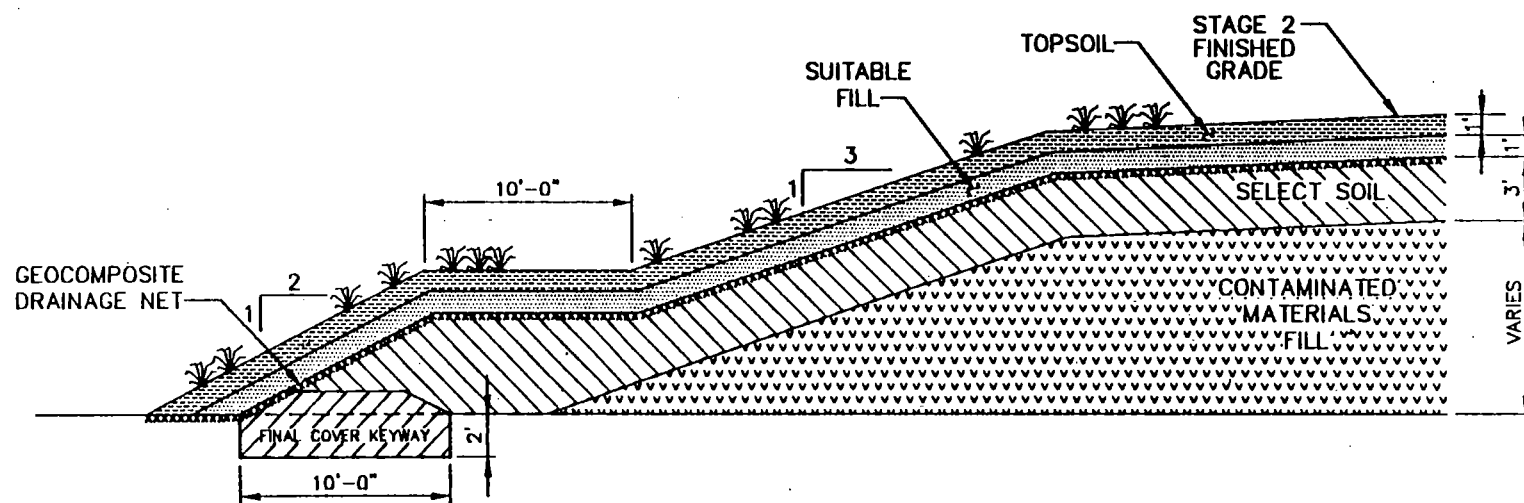


FIGURE 2-5

**STAGE 2 COVER DETAIL
ECC SITE
ZIONSVILLE, INDIANA**

NOT DRAWN TO SCALE

SOURCE: DOW ENVIRONMENTAL DRAWING C-13, REVISION 0 DATED 11/10/95.



shallow, laterally growing roots, such as grass (which may include red fescue and Kentucky blue grass).

The Settling Defendants shall conduct periodic inspections and shall repair the cap as necessary to ensure its integrity in accordance with the time periods set forth in 40 CFR Sections 265.117 and 265.118 or 329 IAC Sections 3-21-8 and 3-21-9.

2.1.4 Access Restrictions

Access restrictions to be implemented by the Settling Defendants will consist of a fence around the site perimeter and the posting of warning signs. In addition, Settling Defendants will use "best efforts," as that term is used in Section X A. of the Decree, to have recorded appropriate restrictions with the County Recorder's Office prohibiting, (a) usage of the site for excavation and development; (b) usage of ground water from the Site; and (c) installation of new water wells other than monitoring wells.

2.1.5 Subsurface and Surface Water Monitoring

The monitoring activities will:

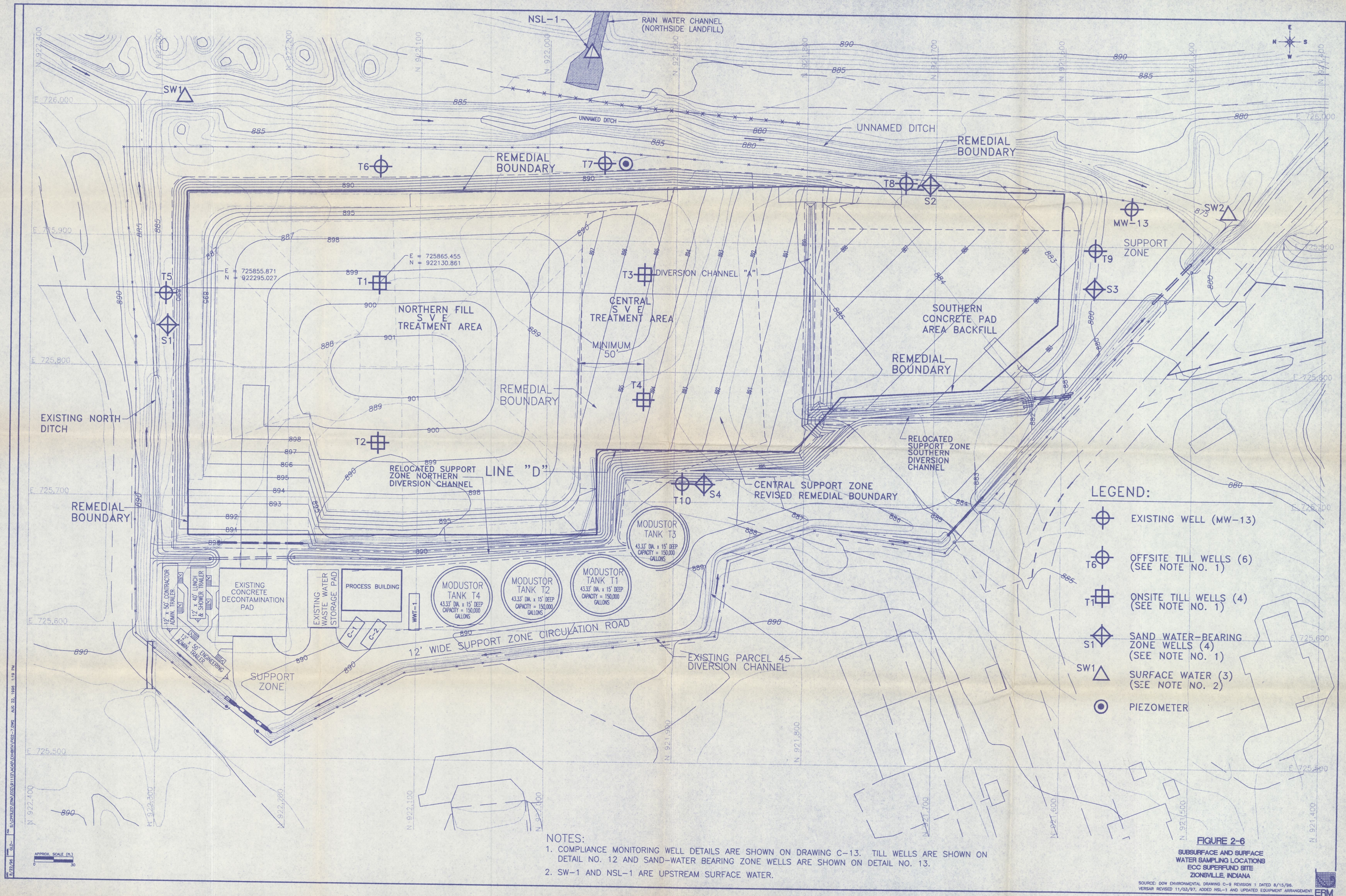
- Measure the concentration of the VOCs, base neutral/acid organics, polychlorinated biphenyls (PCBs), and heavy metals specified in Table 3-1 in the subsurface and surface water during and after vapor extraction; and
- Provide information to determine the effectiveness of the SVE program.

Two types of subsurface water monitoring systems will be installed under this RRA. The first is an on-site till³ monitoring system consisting of four wells screened in the saturated zone of the till. The location of these on-site till wells is shown in Figure 2-6. In accordance with Section 4, sampling results from the on-site till wells will be compared to the Acceptable Subsurface Water Concentrations in Table 3-1 or the Applicable Subsurface Water Background Concentrations of Table 3-1 ("Applicable Subsurface Water Background Concentrations").

During the operation of the SVE System, samples from the on-site till monitoring wells will be collected at the beginning of the SVE operation, semiannually for the first two years of operation and quarterly after that, if operation of the SVE system is continuing during such periods. Every time samples are collected from the on-site wells, the SVE system will be shut down to allow water, if any, to stabilize within the till. Samples collected from the on-site wells will be analyzed for those parameters listed under

³ The saturated shallow unconsolidated glacial deposits composed predominantly of vertically heterogeneous clays and silts with occasional fine-to-coarse sand lenses.

FIGURE 2-6



LEGEND:

- EXISTING WELL (MW-13)
- OFFSITE TILL WELLS (6)
(SEE NOTE NO. 1)
- ONSITE TILL WELLS (4)
(SEE NOTE NO. 1)
- SAND WATER-BEARING
ZONE WELLS (4)
(SEE NOTE NO. 1)
- SURFACE WATER (3)
(SEE NOTE NO. 2)
- PIEZOMETER

NOTES:

1. COMPLIANCE MONITORING WELL DETAILS ARE SHOWN ON DRAWING C-13. TILL WELLS ARE SHOWN ON DETAIL NO. 12 AND SAND-WATER BEARING ZONE WELLS ARE SHOWN ON DETAIL NO. 13.
2. SW-1 AND NSL-1 ARE UPSTREAM SURFACE WATER.

FIGURE 2-6

SUBSURFACE AND SURFACE
WATER SAMPLING LOCATIONS
ECC SUPERFUND SITE
ZIONSVILLE, INDIANA

SOURCE: DOW ENVIRONMENTAL DRAWING C-9 REVISION 1 DATED 8/15/96.
VERSAR REVISED 11/03/97, ADDED NSL-1 AND UPDATED EQUIPMENT ARRANGEMENT



Acceptable Subsurface Water Concentrations in Table 3-1. After achievement of the Acceptable Soil Concentrations, as provided in Section 4.2, SVE operations will be considered to be complete and post-soil clean-up compliance monitoring will begin.

The second type of subsurface water monitoring system consists of off-site wells screened in the till and off-site wells screened in the sand and gravel. Sampling results from these wells will be used to determine compliance with the Acceptable Stream Concentrations in Table 3-1 or the Applicable Surface Water Background Concentrations of Table 3-1. This second subsurface water monitoring network will consist of ten (10) new wells, which will be located around the periphery of and downgradient from the ECC site, and one existing monitoring well, ECC MW-13 (Figure 2-6). In addition, a piezometer will be installed on the east side of the site, as shown in Figure 2-6, to aid in defining the direction of subsurface water flow in the sand and gravel. Six wells will be installed in the till, completed in the saturated zone, and four wells will be completed in the sand and gravel unit underlying the saturated surface till.

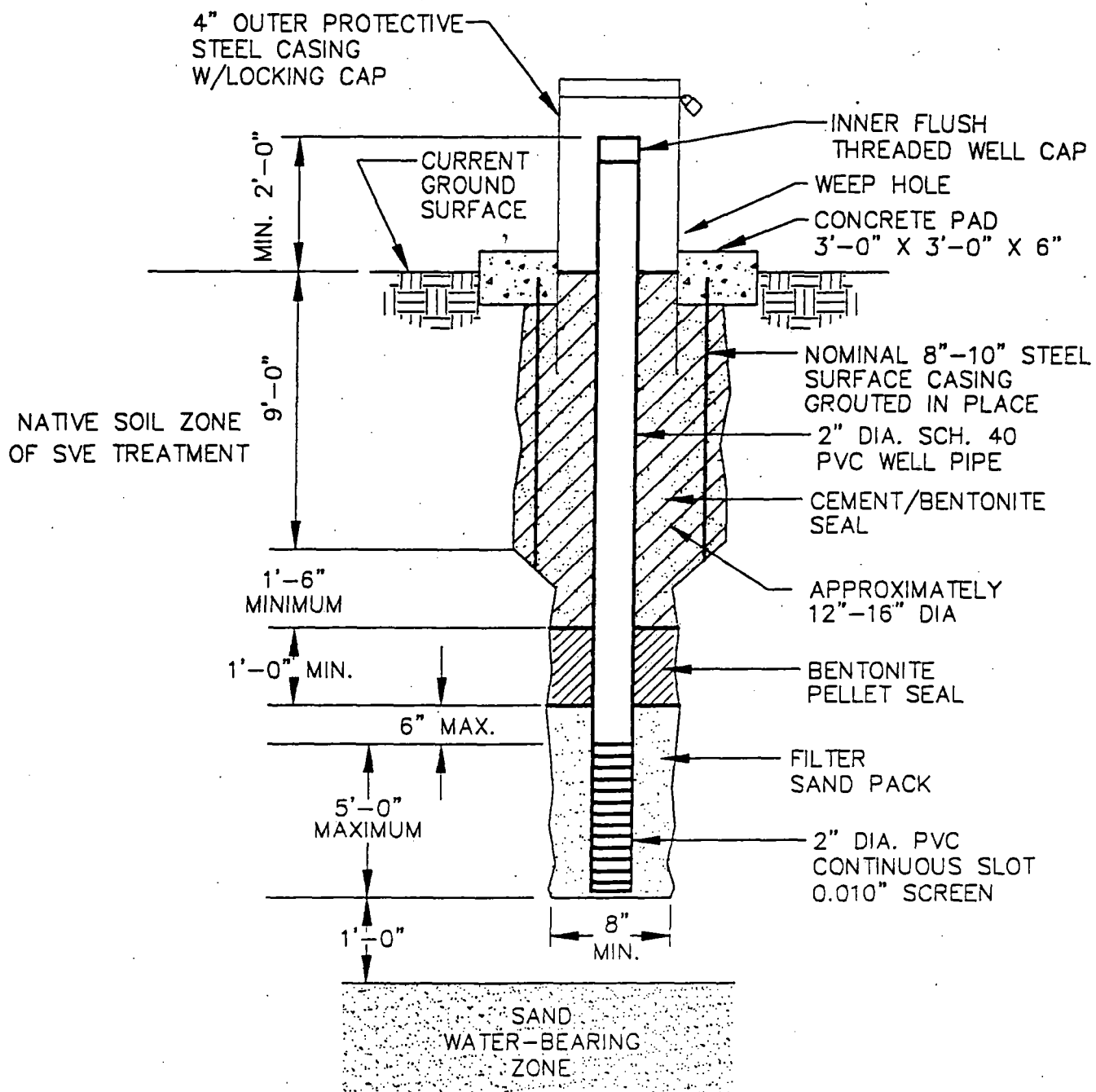
All wells (on-site and off-site) will be constructed of 2-inch polyvinyl chloride (PVC) pipe. Screen length will vary for each well. Total depth for the wells completed in the till will be 1 to 2 feet less than total depth to the contact between the till and underlying sand and gravel. Wells completed in the sand and gravel will screen the total thickness of that sand and gravel unit. Screens will have a 0.01-inch opening. Wells will have a sand pack to 1 foot above the top of screen and a bentonite grout to the ground surface. Well installation will be coordinated with, and consistent with installation of the Phase 1 cover described in Section 2.1.3. Figures 2-7 and 2-8 illustrate well construction details for the two subsurface water monitoring wells in the till, which are located in the northern SVE treatment area, and the two subsurface water monitoring wells in the till, which are located in the central SVE treatment area, respectively. Figure 2-10 illustrates well construction details for the subsurface water monitoring wells located in the sand and gravel. Details of the piezometer construction are shown in Figure 2-10. The location of the monitoring wells is based on the subsurface water elevation contours shown in Figure 2-11.

During the operation of the SVE system, samples from the off-site wells will be collected quarterly for the first year, semiannually for the second year and quarterly thereafter, if operation of the SVE system is continuing during such periods. The samples will be analyzed for the parameters with Acceptable Stream Concentrations in Table 3-1. After achievement of the Acceptable Soil Concentrations as provided in Section 4.2, SVE operations will be considered to be complete and post-clean-up monitoring will begin.

The surface water will be monitored by sampling the Unnamed Ditch just upgradient and just downgradient of the ECC site as depicted generally in Figure 2-6. Surface water will be sampled at the same frequency as the off-site subsurface water and analyzed for the parameters with Acceptable Stream Concentrations in Table 3-1.



SOURCE: DOW ENVIRONMENTAL DRAWING C-13,
DETAIL 12, REVISION 0, DATED 11/10/95.



NOTE:

SVE = SOIL VAPOR EXTRACTION

FIGURE 2-8

**TYPICAL MONITORING WELL CONSTRUCTION
DETAIL - WELL IN GLACIAL TILL
CENTRAL SVE TREATMENT AREA
ECC SITE
ZIONSVILLE, INDIANA**

NOT DRAWN TO SCALE

SOURCE: DOW ENVIRONMENTAL DRAWING C-13,
DETAIL 12, REVISION 0, DATED 11/10/95.



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**TYPICAL MONITORING WELL CONSTRUCTION
DETAIL - WELL IN SAND & GRAVEL
ECC SITE
ZIONSVILLE, INDIANA**

SOURCE: DOW ENVIRONMENTAL DRAWING C-13,
DETAIL 13, REVISION 0 DATED 11/10/95.



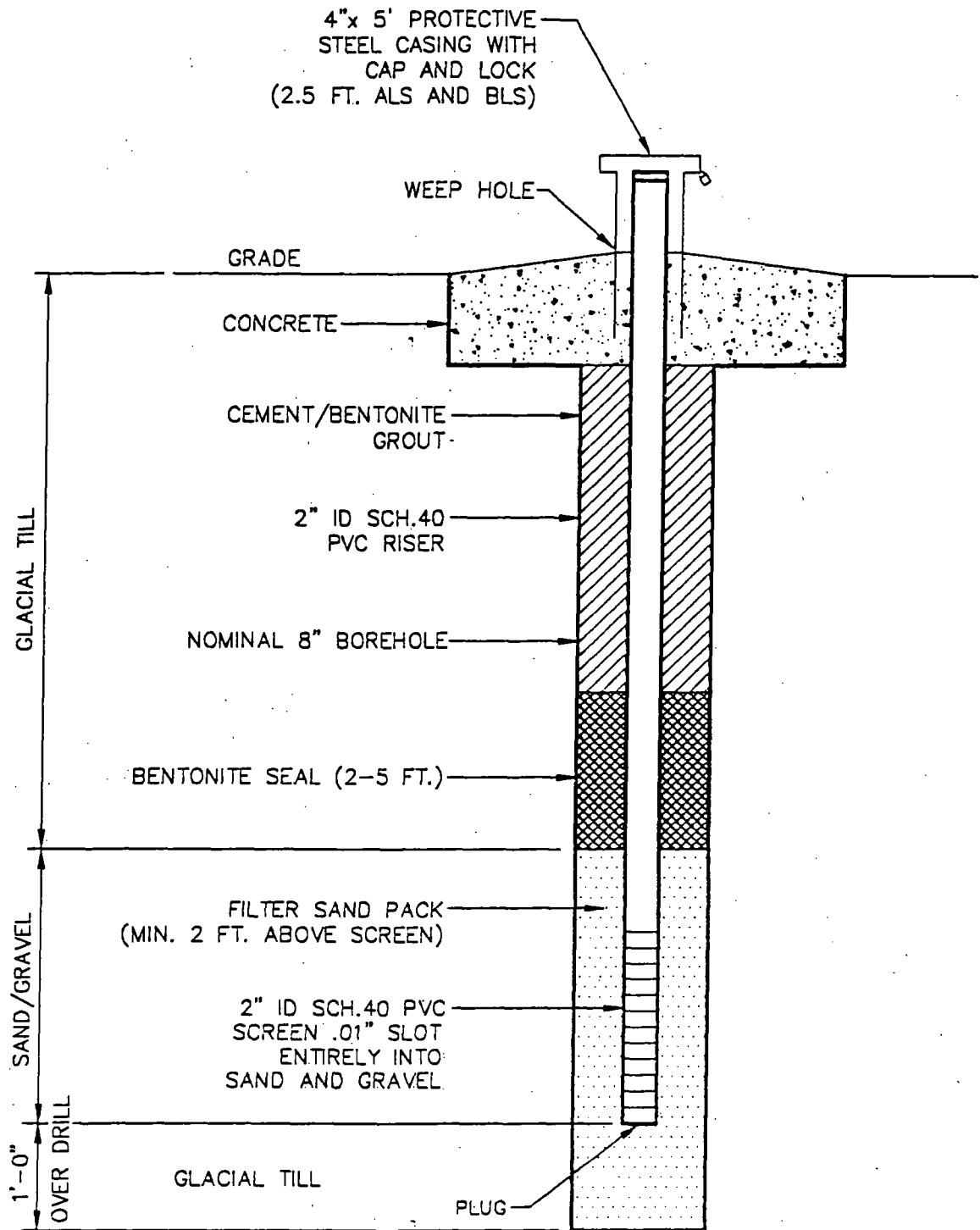
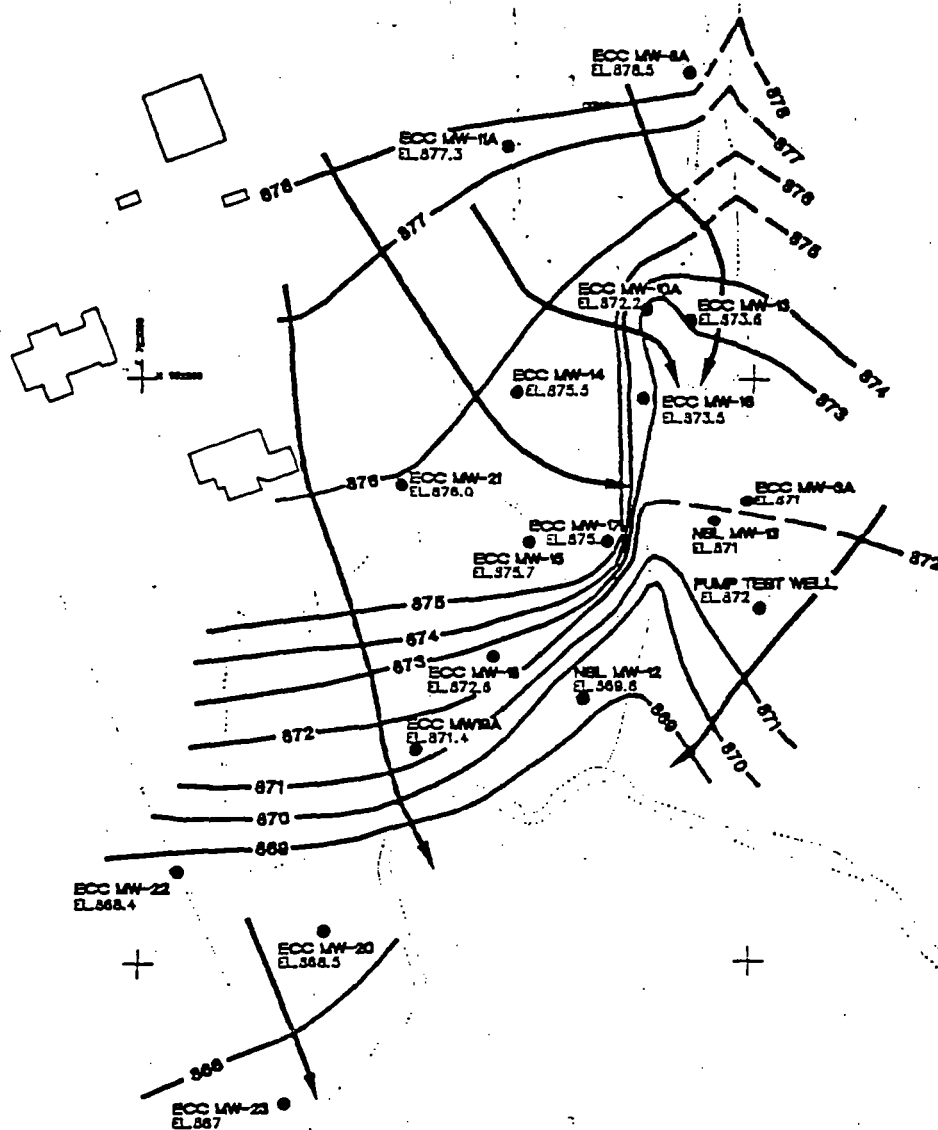
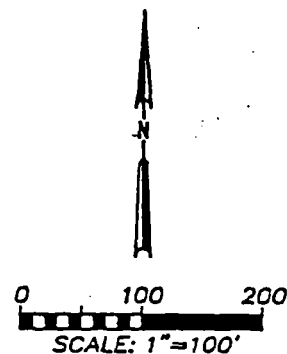


FIGURE 2-10
TYPICAL PIEZOMETER
CONSTRUCTION DETAIL
INSTALLED IN SAND AND GRAVEL
ECC SITE
ZIONSVILLE, INDIANA

NOT DRAWN TO SCALE





LEGEND

- 868 — POTENTIOMETRIC SURFACE CONTOUR FOR SAND AND GRAVEL AQUIFER, CONTOUR INTERVAL: 1 FOOT.
- - - 868 - - - INFERRED POTENTIOMETRIC SURFACE CONTOUR
- DIRECTION OF GROUNDWATER MOVEMENT IN SURFICIAL AQUIFER

NOTE: Contours have been drawn to suggest that the pond is not hydraulically connected to the sand and gravel aquifer. This relationship has not been fully established.

FIGURE 2-11

POTENTIOMETRIC SURFACE MAP OF UPPER SAND AND GRAVEL AQUIFER ECC SITE ZIONSVILLE, INDIANA

SOURCE:
CH2M HILL TECHNICAL MEMORANDUM
NO.2, DATED SEPTEMBER 16, 1988.



3.0 REMEDIAL ACTION CLEAN-UP STANDARDS

This section presents site-specific Clean-up Standards to be used at the ECC site as the criteria for determining completion of remedial action. The Clean-up Standards in this section are the basis for establishing the criteria for Soil Clean-up Verification presented in Section 4.2, and the Post-Soil Clean-up Verification Compliance Monitoring in Section 4.3. If Soil Clean-up Verification as defined in Section 4.2 is not achieved within 5 years of commencing operation of the SVE system, the Additional Work Provisions of Section VII of the Consent Decree will apply.

3.1 Clean-up Standards

The following Clean-up Standards will be met for successful completion of the SVE program:

- Acceptable Soil Concentrations shown in Table 3-1 will be achieved according to the procedure discussed in Section 4.2.3 of Exhibit A,
- Acceptable Stream Concentrations in accordance with Table 3-1 will be achieved in samples collected from the Unnamed Ditch at the downstream location shown on Figure 2-6.
- Acceptable Subsurface Water Concentrations as shown in Table 3-1 (or Applicable Subsurface Water Background Concentrations) in the on-site till wells will be achieved according to the procedures described in Section 4.2.2 of Exhibit A, and
- Acceptable Stream Concentrations or Applicable Surface Water Background Concentrations shown in Table 3-1 in the off-site wells will be achieved according to the procedures in Section 4.3 of Exhibit A.

The term "Table 3-1" wherever referred to or used in this Exhibit A and in the Consent Decree includes the footnotes on pages 3 and 4 of that table.

3.2 Calculation of Clean-up Standards

Table 3-1 sets forth the ECC site-specific clean-up standards and the procedure for determining Applicable Surface Water and Subsurface Water Background Concentrations. The equations for calculation of the risk, supporting data, and complete references are included in Appendix B.

TABLE 3-1
SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA
(Page 1 of 4)

Parameter	Acceptable Subsurface Water Concentration ^{1,2} (ug/L)	Acceptable Stream Concentration ^{3,4} (ug/L)	Acceptable Soil Concentration ^{5,6} (ug/kg)
Volatile Organic Compounds			
Acetone	3,500 RB		2,196
1,1-Dichloroethene	7 MCL	1.85	762
1,2-Dichloroethene(total)	70 MCL	1.85	5,782
Ethyl benzene	680 MCL	3,280	207,464
Methylene chloride	4.7 RB	15.7	126
Methyl ethyl ketone	170 LDWHA		352
Methyl isobutyl ketone	1,750 RB		18,200
Tetrachloroethene	0.69 RB	8.85	77
Toluene	2,000 MCL	3,400	546,134
1,1,1-Trichloroethane	200 MCL	5,280	47,871
1,1,2-Trichloroethane	0.61 RB	41.8	71
Trichloroethene	5 MCL	80.7	812
Vinyl chloride	2 MCL	525	8.3
Total Xylenes	10,000 MCL		5,596,192
Semivolatile Organic Compounds			
bis(2-ethylhexyl)phthalate	2.5 RB	50,000	
Di-n-butyl phthalate	3,500 RB	154,000	
1,2-Dichlorobenzene	600 MCL	763	370,160
Diethyl phthalate	28,000 RB	52,100	
Isophorone	8.5 RB		
Naphthalene	14,000 RB	620	
Phenol	1,400 RB	570	51,680

TABLE 3-1
SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA
(Page 2 of 4)

Parameter	Acceptable Subsurface Water Concentration ^{1,2} (ug/L)	Acceptable Stream Concentration ^{3,4} (ug/L)	Acceptable Soil Concentration ^{5,6} (mg/kg)
Inorganics			
Antimony	14 RB		
Arsenic	50 MCL (10)	0.0175 (10)	
Barium	1,000 MCL		
Beryllium	4 MCL		
Cadmium	10 MCL		
Chromium VI	50 MCL	11	
Lead	50 MCL	10	
Manganese	7,000 RB		
Nickel	150 LDWHA	100	
Silver	50 MCL		
Tin	21,000 RB		
Vanadium	245 RB		
Zinc	7,000 RB	47	
Cyanide	154 LDWHA	5.2	
Polychlorinated biphenyls	0.0045 RB (7)	0.000079 (7,8)	

Notes:

¹ RB = Risk-based standard. U.S. EPA, Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals), December 1991.

EPA = Letter from Michael McAteer of United States Environmental Protection Agency to the Enviro-Chem Trustees, October 12, 1995.

MCL = Drinking water Maximum Contaminant Level. 40 CFR 141

LDWHA = Lifetime drinking water health advisory. U.S. EPA, Superfund Public Health Evaluation Manual update of November 16, 1987.

TABLE 3-1
SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA
(Page 3 of 4)

Notes: (continued)

² In the event that higher concentrations than those set forth for any parameter in this column are present in the upgradient subsurface water in the till and/or sand and gravel according to the procedure specified below, then those higher upgradient subsurface water concentrations and not the values set forth in this table shall constitute the Acceptable Subsurface Water Concentrations within the meaning of this Exhibit A and the Consent Decree. Those upgradient subsurface water concentrations are referred to in this Exhibit A as "Applicable Subsurface Water Background Concentrations." Twelve subsurface water samples will be taken from existing or new well locations, approved by EPA, over at least a 12-month period in areas upgradient of the site. The exact procedure, location of wells, and schedule for collecting and analyzing the samples will be approved by EPA, after consultation with the state, prior to its implementation. Subsurface samples for inorganics and PCB analysis will be filtered. For each parameter, the analytical results from the 12 samples will be analyzed using standard statistical procedures. The mean and standard deviation will be calculated, and all nondetects will be assigned a value equal to 1/2 the EPA-approved quantification limit. For purposes of this Document, "Applicable Subsurface Water Background Concentrations" is defined as two (2) standard deviations above the calculated mean of these 12 samples.

³ Stream Criteria, from Table 1 of the Record of Decision for the site, September 25, 1987 (or calculated on the same basis).

⁴ In the event that higher concentrations than those set forth for any parameter in this column are present in the upstream surface water, then those higher upstream concentrations and not the values set forth in this table shall constitute the Acceptable Stream Concentrations within the meaning of this Exhibit A and the Consent Decree. Those higher upstream surface water concentrations are referred to in this Exhibit A as "Applicable Surface Water Background Concentrations." Twelve surface water samples will be taken from Unnamed Ditch upstream of the site over at least a 12 month period. The exact procedure, location of samples, and schedule for collecting and analyzing the samples will be approved by EPA, after consultation with the state, prior to its implementation. For each parameter, the analytical results from the 12 samples will be analyzed using standard statistical procedures. The mean and standard deviation will be calculated, and all nondetects will be assigned a value equal to 1/2 the EPA- approved quantification limit. For purposes of this document, "Applicable Surface Water Background Concentrations" is defined as two (2) standard deviations above the calculated mean of these 12 samples.

⁵ Acceptable Soil Concentration is based on ingestion of subsurface water at the site boundary, assuming a dilution of leachate to subsurface water of 1:196 (Appendix B).

TABLE 3-1
SITE-SPECIFIC ACCEPTABLE CONCENTRATIONS
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA
(Page 4 of 4).

Notes: (continued)

- ⁶ The Acceptable Soil Concentrations, within the meaning of this Exhibit A and the Consent Decree, will be achieved when the arithmetic average of the soil sample results for each parameter, assigning all nondetect results a value of 1/2 the detection limit, do not exceed the values set forth in this table by more than 25%.
- ⁷ So long as the EPA-approved quantification limit for PCBs in water is above the acceptable subsurface water and stream concentrations for PCBs, compliance with the Acceptable Subsurface and Stream Concentrations for PCBs will be determined as follows: all subsurface and surface water sample results for PCBs must be below the EPA-approved quantification limit for PCBs (at the time compliance is determined).
- ⁸ Modified from Superfund Public Health Evaluation Manual, October, 1986, EPA 4/540/1-86/060, OSWER Directive 9285.4 1.
- ⁹ Revised Site-Specific Acceptable Soil Concentrations were calculated in accordance with the procedures in Appendix B of Exhibit A using updated Acceptable Subsurface Water Concentrations (shaded) and the f_{α} value corresponding to the 90% lower confidence limit of the mean of the TOC values from the TOC Investigation.
- ¹⁰ So long as the EPA-approved quantification limit for arsenic in water is above the acceptable subsurface water and stream concentrations for arsenic, compliance with the Acceptable Subsurface and Stream Concentrations for arsenic will be determined as follows: all subsurface and surface water sample results for arsenic must be below the EPA-approved quantification limit for arsenic (at the time compliance is determined).

The calculation of risk-based concentrations shown in Table 3-1 follows the procedures presented in the USEPA Draft RCRA Facility Investigation (RFI) Guidance, dated July 1987, and in the USEPA Memorandum on Interim Final Guidance for Soil Ingestion Rates, dated January 27, 1989. In accordance with this latter reference, the soil ingestion rate for risk calculation was either 0.1 grams of soil per day for a 70 kilogram (kg) person for 70 years (for compounds with potency factors) or 0.2 grams of soil per day for a 17 kg child for 5 years (for compounds with reference doses). In accordance with the RFI Guidance document referenced above, the ingestion rate used for the risk calculation was 2 liters of water per day by a 70 kg person for 70 years.

Three columns of data, corresponding to Acceptable Concentrations for Subsurface Water, Stream and Soil are presented in Table 3-1. Additionally, Applicable Subsurface Water Background Concentrations, and Applicable Surface Water Background Concentrations are defined in Table 3-1. The Acceptable Subsurface Water Concentrations are based on either drinking water standards or criteria (Maximum Contaminant Level [MCL] or lifetime drinking water health advisory [LDWH]), or the appropriate risk-based concentration. These limits assume, as a worst case, that the subsurface water in the till could be utilized as a lifetime source of drinking water. However, the use of the subsurface water in the till as a source of drinking water was rejected as unlikely in the ECC Remedial Investigation (RI), pages 6-22. As a result, the use of drinking water standards and risk-based standards; based on daily, long-term human consumption of the till water for clean-up standards under this RRA, represents an extremely conservative assumption when the real-life risks, if any, presented by the ECC site are considered.

The Acceptable Stream Concentrations are taken from the Record of Decision (ROD) for the site, dated September 25, 1987, or subsequently calculated using the same methodology.

The Acceptable Soil Concentrations in Table 3-1 are based on the lowest of the risk-based concentrations for soil or subsurface water ingestion, from Tables B5 and B6.

Table 3-2 presents the compounds detected in soils at the site at levels above the Acceptable Soil Concentrations specified in Table 3-1. Table 3-3 shows the vapor pressure and solubility of these compounds.

3.3 Additional Work

If additional work is required under Section VII of the Consent Decree, Settling Defendants shall perform the following additional work at the site unless the parties agree otherwise:

- Maintain the RCRA-Compliant (Subtitle C) Cover and the access restrictions.

TABLE 3-2
COMPOUNDS DETECTED IN THE SOIL AT CONCENTRATIONS
ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Parameter	Acceptable Soil Concentration (ug/kg)	Maximum Detected Concentration (ug/kg)
Volatile Organic Compounds		
Acetone	2,200	650,000
1,1-Dichloroethene	760	35,000
1,2-Dichloroethene(total)	5,780	120,000
Ethyl benzene	207,460	1,500,000
Methylene chloride	130	310,000
Methyl ethyl ketone	350	2,800,000
Methyl isobutyl ketone	18,200	190,000
Tetrachloroethene	77	650,000
Toluene	546,130	2,000,000
1,1,1-Trichloroethane	47,870	1,100,000
1,1,2-Trichloroethane	70	556
Trichloroethene	810	4,800,000
Total Xylenes	5,596,190	6,800,000
Semivolatile Organic Compounds		
1,2-Dichlorobenzene	370,160	900,000
Phenol	51,680	570,000

Note:

¹ Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

TABLE 3-3
CHEMICAL PROPERTIES OF ORGANIC COMPOUNDS
DETECTED IN THE SOILS AT CONCENTRATIONS
ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Parameter	Solubility (ug/L)	Vapor Pressure (mm Hg)
Volatile Organic Compounds		
Acetone	1,000,000,000	270
1,1-Dichloroethene	2,250,000	600
1,2-Dichloroethene(total)	700,000	324
Ethyl benzene	152,000	7
Methylene chloride	20,000,000	362
Methyl ethyl ketone	268,000,000	77.5
Methyl isobutyl ketone	17,000,000	6
Tetrachloroethene	200,000	17.8
Toluene	535,000	28.1
1,1,1-Trichloroethane	4,400,000	123
1,1,2-Trichloroethane	4,500,000	30
Trichloroethene	1,100,000	57.9
Total Xylenes	198,000	10
Semivolatile Organic Compounds		
1,2-Dichlorobenzene	145,000	1
Phenol	93,000,000	0.341

Note:

¹ Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

References:

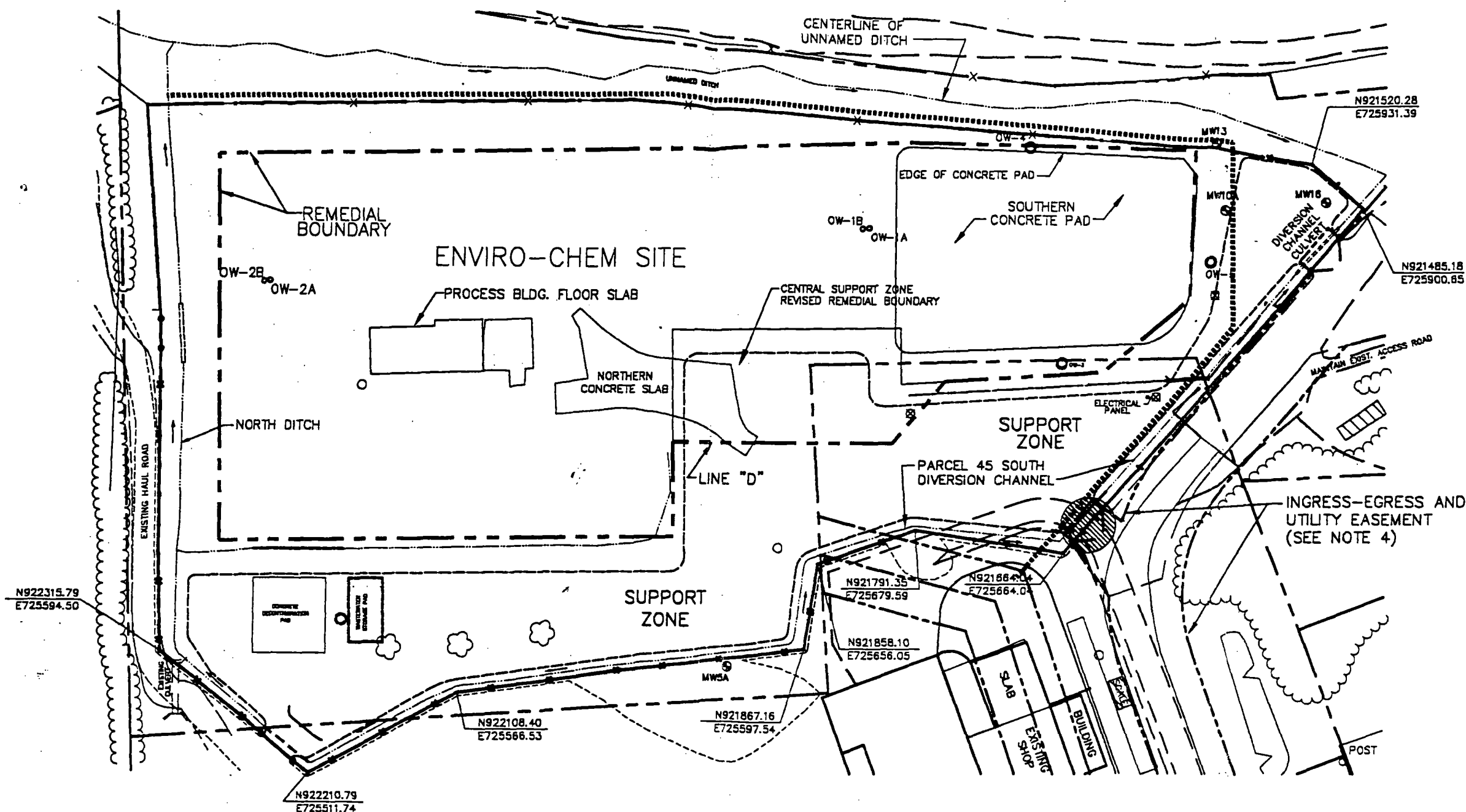
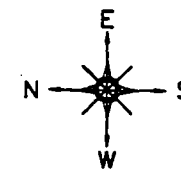
U.S. EPA, "Superfund Public Health Evaluation Manual," 1986.

U.S. EPA, "Water-Related Environmental Fate of 129 Priority Pollutants," December 1979.

U.S. EPA, "Handbook of RCRA Ground-Water Monitoring Constituents, Chemical and Physical Properties (40 CFR 264, Appendix 9)," September 1992.

- Construct a subsurface water interception trench around the south and east sides of the ECC site as depicted in Figures 3-1 and 3-2.
- Collect and transport subsurface water intercepted in this trench to the Indianapolis publicly owned treatment works (POTW), or provide other appropriate handling and treatment of such waste in accordance with applicable federal and state laws.
- Subsurface water will continue to be removed and handled in this manner until "confirmed" analytical results from two consecutive, semiannual subsurface water samples collected from the interception trench show that the Acceptable Stream Concentrations in Table 3-1 or Applicable Surface Water Background Concentrations have been met, unless the Parties to the Decree otherwise agree.
- Semiannual monitoring of off-site wells and surface water will continue for 5 years after the Acceptable Stream Concentrations in Table 3-1 or Applicable Surface Water Background Concentrations have been achieved.
- If "confirmed" analytical results from two consecutive semiannual samples collected during the 5 years of off-site monitoring in either the surface water or the wells indicate that the same parameter exceeds its Acceptable Stream Concentration or Applicable Surface Water Background Concentration at the same monitoring point, then subsurface water collection and treatment will be reinstituted.

As used in this section and in Section 4.3 below, the term "confirmed" shall permit the Parties to demonstrate that an analytical result is not accurate as a result of errors in sampling, analysis, or evaluation or that it otherwise mischaracterizes the concentration of a parameter. The procedures used to obtain "confirmed" data shall include reanalysis, resampling, and the analysis of only undiluted samples if a concentration is qualified with a "J" (estimated concentration). If after reanalysis and/or resampling using an undiluted sample the concentration of a compound is still qualified with "J," then the result produced from undiluted samples will be used. Samples qualified with a "B" will be considered as "confirmed" data only if the concentrations in the sample exceed 10 times the maximum amount detected in any blank for the media being analyzed.



APPROX. SCALE (ft.)
0 80

SYMBOL LEGEND

- BOUNDARY LINES
- FENCE LINE
- SUBSURFACE WATER INTERCEPTION TRENCH

- NOTES:
- 1.) PROPERTY LINE LOCATIONS AND SURVEY DATA SUPPLIED BY: SCHNEIDER ENGINEERING CORP., INDIANAPOLIS, INDIANA.
 - 2.) COORDINATE GRID IS REFERENCED TO THE INDIANA STATE PLANE COORDINATE SYSTEM.
 - 3.) EXISTING SITE TOPOGRAPHY PROVIDED BY ABRAMS AERIAL SURVEY CORPORATION, AERIAL PHOTOS TAKEN JUNE, 1992. AS-BUILT TOPOGRAPHY WITHIN THE SUPPORT ZONE AND NORTH OF THE REMEDIAL BOUNDARY PROVIDED BY MSE SURVEYING, FEBRUARY AND MARCH, 1994. WITH CORRECTIONS BY DEI, DECEMBER, 1994.
 - 4.) ENVIRO-CHEM ACCESS AND SETTLEMENT AGREEMENT, EXHIBIT A, JULY 18, 1993.

- 5.) DEPTH OF TRENCH WILL VARY DEPENDING ON DEPTH OF GLACIAL TILL LAYER. BOTTOM OF TRENCH TO BE LOCATED ~1'-0" ABOVE UNDERLYING GLACIAL SAND.
- 6.) INTERCEPTION TRENCH WILL BE LOCATED BETWEEN REMEDIAL AREA BOUNDARIES AND UNNAMED DITCHES.
- 7.) LOW POINT(S) FOR INTERCEPTION TRENCH WILL BE DETERMINED DURING FIELD INVESTIGATION. WORK REQUIRED FOR CONSTRUCTION OF THE TRENCH SUMP(S) AND ASSOCIATED PUMPING SYSTEM(S) WILL BE CONSTRUCTED AND INSTALLED BASED UPON LOCATION OF LOW POINT(S). THE LOCATION OF THE SUMP SHOWN IS ILLUSTRATIVE ONLY.

FIGURE 3-1
SUBSURFACE WATER INTERCEPTION TRENCH
ENVIRO - CHEM SITE
ZIONSVILLE, INDIANA



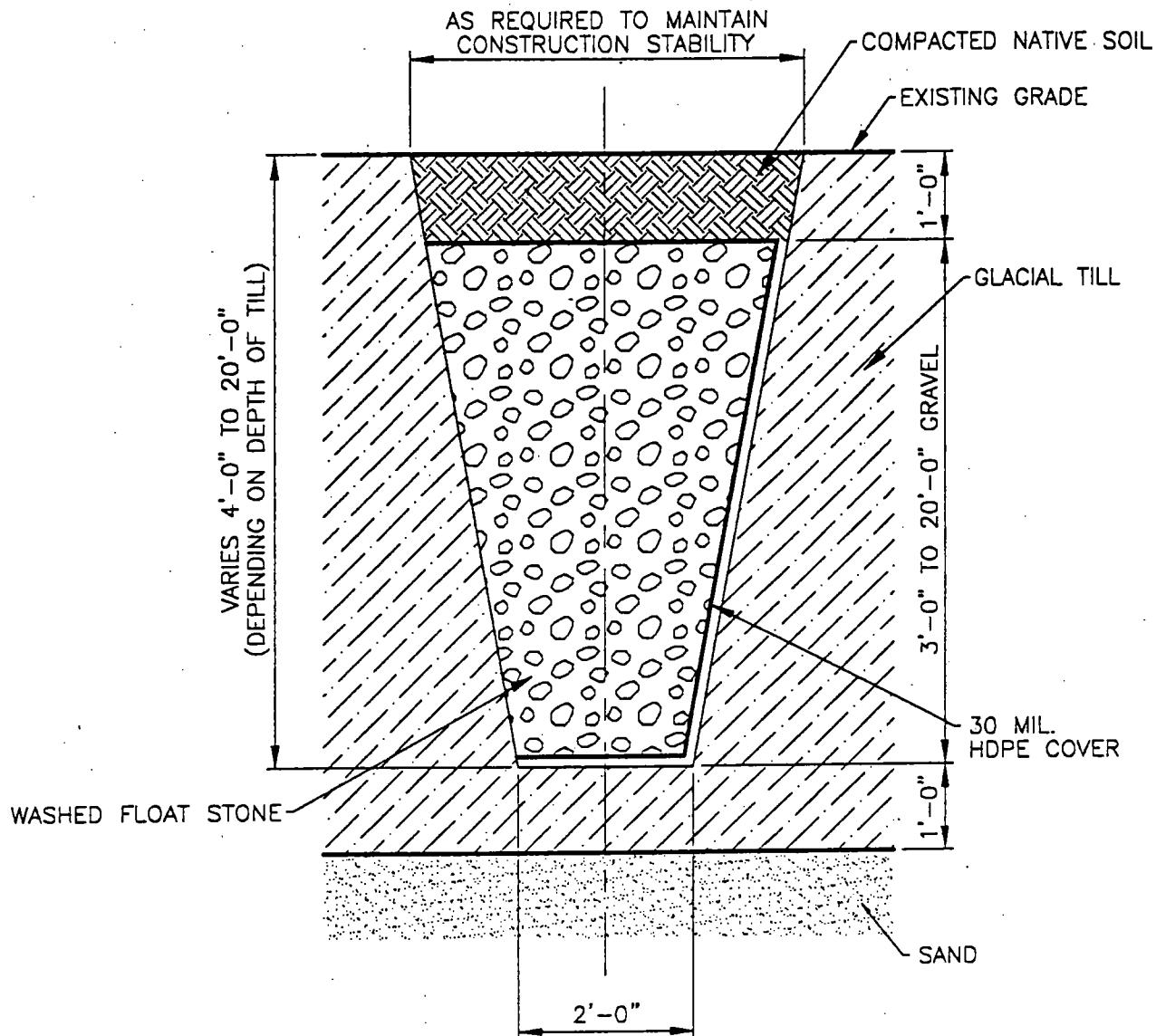


FIGURE 3-2
SUBSURFACE WATER INTERCEPTION TRENCH
CROSS SECTION
ENVIRO - CHEM SITE
ZIONSVILLE, INDIANA

NOT DRAWN TO SCALE



4.0 REMEDIAL ACTION VERIFICATION AND COMPLIANCE MONITORING

The SVE system described herein is designed to achieve the clean-up standards for VOCs as presented in Table 3-1, phenol and 1,2-dichlorobenzene. The time required to accomplish this removal depends on the type of compound and soil, air flow rate and temperature, and efficient diffusion of air through the soil pores. The time required for treatment was estimated using a vapor extraction model, as described below and in Appendix C. Monitoring of vapor from the combined vapor stream and from individual wells and/or trenches, as described below, will also be used to estimate completion of the SVE system operation. Afterwards, verification of soil cleanup will be accomplished by (1) soil vapor monitoring of restart spikes, (2) on-site subsurface till water monitoring, and (3) soil sampling ("Soil Clean-up Verification").

Compliance monitoring will consist of sampling of surface water in the Unnamed Ditch, and sampling of subsurface water in off-site till monitoring wells, sand and gravel monitoring wells, and on-site till monitoring wells ("Compliance Monitoring").

4.1 Estimation of Completion of Vapor Extraction System Operation

A computer model which simulates the vapor extraction system was used to estimate the time required for removal for the maximum detected soil concentrations to the Acceptable Soil Concentrations specified in Table 3-1. Appendix C summarizes the characteristics of the model and the data used.

The vapor extraction system is designed to permit vapor samples to be obtained from each individual extraction well and/or trench and from the combined vapor stream from all operating extraction wells and/or trenches.

The combined vapor flow will be sampled daily during the first week of operation, weekly for the following 4 weeks, and monthly thereafter. Samples will be analyzed for the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of organics removed from the soils and the effectiveness of the system. These data will also aid in estimating the treatment time remaining, based on the calculated mass extraction rate (pounds/day) of the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene.

Vapor samples from individual extraction wells and/or trenches will be collected at the beginning of the vapor extraction system operation to establish a baseline of organics removal per well/trench. These samples will be analyzed for the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene. Additional vapor samples of individual wells and/or trenches will be collected at least every 2 months, to determine when individual extraction wells and/or trenches can be shut down. The criterion for shutting down individual wells and/or trenches will be that two consecutive air samples from an individual well and/or trench show vapor concentrations to be less

Spec
says
1st wk.

than or equal to those that would be in equilibrium with the Acceptable Soil Concentrations in Table 3-1. Table 4-1 shows the soil vapor concentrations in equilibrium with the Acceptable Soil Concentrations for the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene. Appendix D presents the methodology used to arrive at these equilibrium vapor concentrations.

4.2 Soil Clean-up Verification

Verification of soil cleanup will be established when each of the following is met: (1) the soil vapor from the restart spike tests shows compliance with the calculated soil vapor concentrations in equilibrium with Acceptable Soil Concentrations for the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene ("Soil Vapor Criterion"), (2) on-site till wells show compliance with the Acceptable Subsurface Water Concentrations as shown in Table 3-1 or Applicable Subsurface Water Background Concentrations according to the procedures in Section 4.2 ("On-Site Till Water Criterion"), and (3) soil samples show compliance with the Acceptable Soil Concentrations as specified in Table 3-1 ("Soil Sample Criterion"). [If soil clean-up verification is not established, vapor extraction will be restarted. If after 5 years from the initial commencement of SVE (or sooner as permitted in the Decree), Soil Cleanup verification has not been established, then the Additional Work provisions of Section VII of the Consent Decree will apply.

4.2.1 Soil Vapor Criterion

Once the combined vapor flow and individual well/trench vapor samples show concentrations of the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene at or below their respective equilibrium soil vapor concentrations shown in Table 4-1, the "restart spike" method on the combined vapor flow will be used to demonstrate that the Soil Vapor Criterion for Soil Clean-up Verification has been achieved.

The "restart spike" method consists of periodically shutting down and restarting the vapor extraction system. By shutting down the system, equilibrium conditions between the vapor space within the soil and any remaining organics amenable to vapor extraction within the soil matrix are reestablished. Therefore, when the vapor extraction system is restarted, the initial organic compound concentrations in the extracted gas will be higher than under normal operation.

The restart spike procedure will include shutting down the vapor extraction system for a period of 3 days. On restarting the vapor extraction system, all extraction and injection wells and/or trenches will be operated as during normal operation. A sample of the combined soil vapor will be collected over the time period (starting 30 minutes after restarting the vapor extraction system) that is needed to exchange the air in one pore volume of soil to provide a representative sample of the soil vapor concentrations in equilibrium with the soil concentrations.

TABLE 4-1

SOIL VAPOR CONCENTRATIONS IN EQUILIBRIUM
WITH ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Compound ²	Soil Vapor Concentration ³	
	(mg/l)	(ppmv)
Volatile Organics (VOCs):		
Acetone		244
1,1-Dichloroethene	2.0	481
1,2-Dichloroethene (total)	3.7	880
Ethylbenzene	37	8,076
Methylene chloride	0.08	22
Methyl ethyl ketone	0.04	13
Methyl isobutyl ketone	0.69	159
Tetrachloroethene	0.11	16
Toluene	107	27,090
1,1,1-Trichloroethane	8.3	1,442
1,1,2-Trichloroethane	0.01	1
Trichloroethene	0.39	68
Vinyl chloride	919.2	338,808
Total Xylenes	595	130,244
Base Neutral/Acid Organic:		
1,2-Dichlorobenzene	9.3	1,466
Phenol	0.005	1.3

Notes:

¹ Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

² Compounds above Acceptable Soil Concentrations in Table 3-1 to be removed by vapor extraction.

³ From Appendix D.

The Soil Vapor Criterion will be met when analyses of soil vapor samples collected from four consecutive restart spikes conducted once every 2 weeks show that concentrations of the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene are at or below equilibrium soil vapor concentrations shown in Table 4-1 and, therefore, by calculation can be shown to be at or below the Acceptable Soil Concentrations in Table 3-1.

4.2.2 On-site Till Water Criterion

During operation of the SVE system, samples of the subsurface water from the on-site till monitoring wells will be collected semiannually for the first two years and quarterly after that, if the SVE system is continuing to be operated during such periods. Additional samples may be taken at the discretion of the representative of the ECC Trustees. [The most recent sampling results from the four on-site till water monitoring wells following demonstration that the Soil Vapor Criterion has been achieved (Section 4.2.1) will be used to demonstrate that the On-site Till Water Criterion for Soil Clean-up Verification has been achieved. After achievement of the Acceptable Soil Concentrations, as provided in Section 4.2, SVE operations will be considered to be complete and post-clean-up compliance monitoring will begin.

Till monitoring criterion will be met when analyses of the water samples collected from each of the four on-site till wells show that the concentrations for parameters with Acceptable Subsurface Water Concentrations in Table 3-1 are at or below the Acceptable Subsurface Water Concentrations in Table 3-1 or Applicable Subsurface Water Background Concentrations.

4.2.3 Soil Sample Criterion

Once the Soil Vapor Criterion and Onsite Till Water Criterion for Soil Clean-up Verification have been demonstrated as defined above, a minimum of 20 soil samples from areas selected by USEPA and the state will be collected. Each soil sample will be analyzed for the VOCs listed in Table 3-1, phenol and 1,2-dichlorobenzene. If the results from this initial round of soil samples verify that the Acceptable Soil Concentrations in Table 3-1 have been met, then the Soil Sample Criterion for Soil Clean-up Verification will have been achieved.

In the event that the soil sampling results do not verify that the Acceptable Soil Concentrations as defined in Table 3-1 have been met, and the SVE system is operated for an additional period of time, additional soil samples will be taken in the same approximate locations as the initial sample locations where acceptable soil concentrations had not been shown. Results from this second sampling will be analyzed using the identical procedure outlined above to verify that the Acceptable Soil Concentrations in Table 3-1 as described in Footnote 6 of Table 3-1 have been met. If the results from any subsequent round of soil samples demonstrate that the Acceptable Soil Concentrations in Table 3-1 have been met, then the Soil Sample Criterion for Soil Clean-up Verification will have been achieved.

4.3 Post-Soil Clean-up Compliance Monitoring

Once Soil Clean-up Verification has been achieved as prescribed in Section 4.2, sampling of off-site till wells, on-site till wells, off-site sand and gravel wells, and surface water will be conducted for 7 years on a semiannual basis.

Off-site wells and surface water will be analyzed for the parameters with Acceptable Stream Concentrations in Table 3-1. On-site wells will be analyzed for parameters with Acceptable Subsurface Water Concentrations in Table 3-1 in accordance with procedures set forth in Section 4.2.2.

If "confirmed" analytical results from two consecutive semiannual samples collected during the Compliance Monitoring period indicate that the same parameter exceeds its Post-Soil Cleanup Standard (or the Applicable Surface Water or Subsurface Water Background Concentration, whichever is higher) at the same monitoring point, then the Additional Work provisions of Section VII of the Decree will apply. If the conditions set forth in the preceding sentence do not occur, monitoring will be discontinued at the end of the Compliance Monitoring period and the provisions of Section XXVI of the Decree will apply.

5.0 MISCELLANEOUS PROVISIONS AND SCHEDULING

Site preparation for the Remedial Action was completed November 30, 1993, and final documentation of completion of site preparation was provided to USEPA on March 4, 1994. The following documents have been submitted to USEPA and the State for review and approval by USEPA: (1) Revised Remedial Action Pre-Final (90%) Design (including Technical Specifications and Drawings), (2) Health and Safety Plan, (3) Construction Quality Assurance Plan, (4) Quality Assurance Project Plan, and (5) Field Sampling Plan. Comments provided by USEPA and the state to the Prefinal Design documents described above will be addressed by the Settling Defendants.

Specific Remedial Action milestones were established in Section VXII (Stipulated Penalties) of the Consent Decree. The engineering and operational modifications to the original Remedial Action Plan necessitated revisions to the original schedule. The revised schedule for implementing the remedy is presented on Schedule Z in Appendix E.

APPENDIX A
ESTIMATE OF MASS OF ORGANICS IN THE SOILS

APPENDIX A

ESTIMATE OF MASS OF ORGANICS IN THE SOILS ENVIRO-CHEM SUPERFUND SITE ZIONSVILLE, INDIANA

Location	Sampling Depth (ft)	Total Concentration (ug/kg)
TP-01	1 - 1.5	1,972
TP-02	1 - 1.5	28
TP-03	1 - 1.5	108,800
TP-04	1 - 2	99,730
TP-04	2.5 - 3.5	4,416
TP-05	1 - 2	24,287
TP-05	2 - 3	291
TP-06	1 - 2	12,468,000
TP-06	2 - 3	22,690
TP-06	4 - 5	2,416
TP-07	1 - 2.5	267,000
TP-07	2.5 - 4	280,090
TP-08	1 - 2.5	3,687
TP-08	2.5 - 4	433,600
TP-09	1 - 3	14,604,000
TP-09	3 - 5	130
TP-10	1 - 3	958
TP-10	3 - 5	432
TP-11	1 - 3	130
TP-11	3 - 5	67
TP-12	1 - 3	35,030
TP-12	3 - 5	3,609
SB-01	2.5 - 4	3,303
SB-02	2.5 - 4	323,000
SB-03	2.5 - 4	70,070
SB-04	2 - 3.5	1,275
SB-06	2 - 3.5	222,010
SB-08	2.5 - 4	3,012
SB-09	2.5 - 4	61,490
SB-01	5.5 - 7	114
SB-02	5.5 - 7	44
SB-04	5 - 6.5	51
SB-08	7 - 8.5	188
SB-09	5.7 - 7	8,069

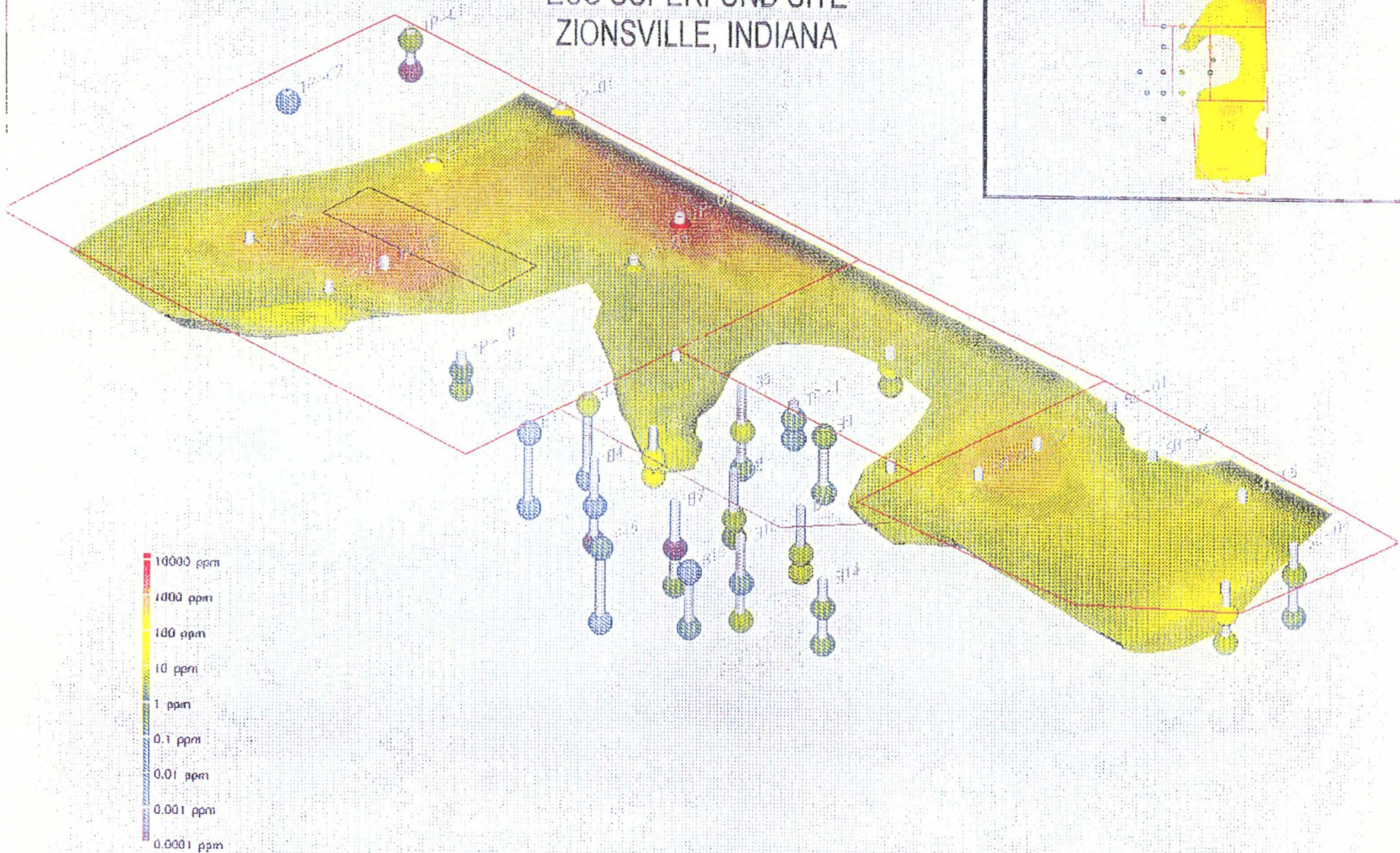
APPENDIX A

ESTIMATE OF MASS OF ORGANICS IN THE SOILS ENVIRO-CHEM SUPERFUND SITE ZIONSVILLE, INDIANA

Location	Sampling Depth (ft)	Total Concentration (ug/kg)
B1	0 - 2	6
B1	8 - 10	13
B2	0 - 2	5,810
B2	8 - 10	54
B3	4 - 6	29,720
B3	6 - 8	57,640
B4	4 - 6	6
B4	8 - 10	0
B5	2 - 4	33,210
B5	4 - 6	41,300
B6	4 - 6	8,237
B6	8 - 10	155
B7	4 - 6	0
B7	8 - 10	247
B8	4 - 6	2,410
B8	6 - 8	1,216
B9	0 - 2	468
B9	6 - 8	212
B10	4 - 6	84
B10	8 - 10	4,300
B11	4 - 6	4,470
B11	6 - 8	7,000
B12	2 - 4	122,360
B12	4 - 6	12,970
B13	2 - 4	156
B13	6 - 8	40
B14	2 - 4	463
B14	6 - 8	326
B15	0 - 2	66
B15	8 - 10	5
B16	0 - 2	4
B16	6 - 8	68

Total organics to be removed by vapor extraction as calculated by three dimensional kriging on total concentration using EVS is 2,164 pounds.

FIGURE A1
TOTAL CONCENTRATION OF VOCs
ECC SUPERFUND SITE
ZIONSVILLE, INDIANA



APPENDIX B CALCULATION OF RISK-BASED CLEAN-UP STANDARDS

The equations used to calculate risk-based concentrations are shown in Table B1. The values used in the equations are listed in Table B2. The potency factors and reference doses for compounds without any regulatory or background level are from a memorandum from the USEPA Toxics Integration Branch, OERR, Washington, D.C., dated December 19, 1988, with the corrections to the July 1988 update of the characterization tables in the Superfund Public Health Evaluation Manual.

Table B3 presents the calculation of risk-based acceptable subsurface water concentrations in the till for compounds without a regulatory limit [drinking water Maximum Contaminant Level (MCL), or lifetime drinking water health (LDWH) advisory or a stream criterion as listed in Table 1 of the Record of Decision for the site]. Table B4 shows that the resulting concentrations of inorganic compounds at Unnamed Ditch should be below the Stream Criteria presented in Table 1 of the Record of Decision (ROD) for the site, dated September 25, 1987 (or calculated on the same basis). The dilution obtained from discharge of the subsurface water in the till to Unnamed Ditch is 1:1800, as presented in Appendix C of the ECC Remedial Investigation. Note that most of the calculated concentrations in the ditch are below detection limits.

Tables B5 and B6 list the acceptable risk-based soil concentrations, based on soil and subsurface water ingestion, respectively. Acceptable Subsurface Water Concentrations are based on either drinking water standards or criteria (MCL or LDWH) or the appropriate risk-based concentration from Table B3. The values for MCLs, LDWHs, oral slope factors, and reference doses in Tables B5 and B6 are those that were current in 1989 with two exceptions: (1) the MCL for xylene was updated to 10,000 $\mu\text{g/L}$, and (2) the risk-based concentration for 1,1-dichloroethane was updated to 810 $\mu\text{g/L}$. The calculation of acceptable soil concentrations based on subsurface water ingestion follows the procedures presented in Appendix C of the ECC RI. Table B6 shows the values for K_{ow} . Only those organic compounds without regulatory limit (USEPA, Polychlorinated Biphenyls Spill Cleanup Policy Rule, 40 CFR Part 761) in soils are listed in Tables B5 and B6. It is conservatively assumed that the volume of leachate from the soils will be reduced by 99% from the 7.8 in/yr used in the RI, by installing the RCRA-compliant (Subtitle C) cover over the site.

A range of acceptable soil concentrations based on water ingestion using the published ranges for organic carbon content of till soils and the SARA range of risk for Superfund site cleanups, is presented in Table B7. Analytical results of organic carbon content measured in soil samples collected from the site are shown in Table B8. The concentrations shown in Table B6 were used to determine the Acceptable Soil Concentrations specified in Table 3-1, using a risk of 10^{-6} and a soil organic carbon

content of 0.86% (i.e., the 95% Lower Confidence Limit of the "true mean" organic carbon content for the site soil calculated following the procedure outlined in USEPA SW-846 Test Methods for Evaluating Solid Waste).

Table B9 lists the solubility and vapor pressure of the organic compounds detected in the soils above the limits shown in Tables B5 and B6. All compounds, except bis(2-ethylhexyl)phthalate and Aroclor-1260, are amenable to removal by soil vapor extraction.

Finally, Table B10 presents the complete list of references used for the calculation of the Acceptable Soil Concentrations specified in Table 3-1.

TABLE B1

EQUATIONS USED TO CALCULATE RISK-BASED CONCENTRATIONS
ENVIRO-CHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

SOIL (concentrations in ug/kg):

$$\frac{\text{Risk} * \text{Body Weight (kg)} * 1000 \text{ (ug/mg)} * 1000 \text{ (g/kg)}}{\text{Ingestion rate (g/day)} * \text{Potency Factor (mg/kg/day)}^{-1}}$$

or

$$\frac{\text{Risk} * \text{Body weight (kg)} * \text{Reference Dose (mg/kg/day)} * 1000 \text{ (ug/mg)} * 1000 \text{ (g/kg)}}{\text{Ingestion rate (g/day)}}$$

SUBSURFACE WATER (concentrations in ug/l):

$$\frac{\text{Risk} * \text{Body Weight (kg)} * 1000 \text{ (ug/mg)}}{\text{Ingestion rate (l/day)} * \text{Potency Factor (mg/kg/day)}^{-1}}$$

or

$$\frac{\text{Risk} * \text{Body Weight (kg)} * \text{Reference Dose (mg/kg/day)} * 1000 \text{ (ug/mg)}}{\text{Ingestion rate (l/day)}}$$

TABLE B2

INGESTION RATES AND ACCEPTABLE RISKS
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

INGESTION RATES(1):

Soils:

0.1 grams per day by a 70 kilogram person for 70 years

or

0.2 grams per day by a 17 kilogram person for 5 years

Subsurface water:

2 liters of water per day by a 70 kilogram person for 70 years

ACCEPTABLE RISKS:

Compounds with Potency Factors:

10^{-6}

Compounds with Reference Doses:

1

Note:

- (1) From U.S. EPA, RCRA Facility Investigation Guidance, 1987, and U.S. EPA, Office of Solid Waste and Emergency Response, Memorandum on Interim Final Guidance for Soil Ingestion Rates, January 27, 1989.

TABLE B3

ACCEPTABLE HEALTH-BASED SUBSURFACE WATER CONCENTRATIONS
 ENVIROCHEM SUPERFUND SITE
 ZIONSVILLE, INDIANA

Compound ¹	Potency Factor ² (mg/kg/day) ⁻¹	Reference Dose ² (mg/kg/day)	Acceptable Health-Based Subsurface Water Concentration ³ (ug/l)
Volatile Organic Compounds			
Acetone		0.1	3,500
Methylene chloride	0.0075		4.7
Methyl Isobutyl Ketone		0.05	1,750
Tetrachloroethene	0.051		0.69
1,1,2-Trichloroethane	0.057		0.61
Base Neutral/Acid Organics			
Bis(2-ethylhexyl)phthalate	0.014		2.5
Di-n-Butyl Phthalate		0.1	3,500
Diethyl Phthalate		0.8	28,000
Isophorone	0.00410		8.5
Napthalene		0.4	14,000
Phenol		0.04	1,400
Pesticides/PCBs			
Aroclor-1232	7.7		0.0045
Aroclor-1260	7.7		0.0045
Inorganics			
Antimony		0.0004	14
Beryllium		0.005	175
Manganese		0.200	7,000
Tin		0.6	21,000
Vanadium		0.007	245
Zinc		0.2	7,000

Notes:

¹ Only compounds without a regulatory limit [drinking water Maximum Contaminant Level (MCL) (40 CFR 141), proposed MCL goal (40 CFR 141), or lifetime health advisory) are shown.

² From USEPA Toxics Integration Branch, OERR, Washington, D.C. December 1988 correction to the July 1988 Update of the Risk Characterization Tables in the Superfund Public Health Evaluation Manual.

³ Acceptable subsurface water concentrations calculated using an ingestion rate of 2 liters per day by a 70 kg adult for 70 years. Acceptable risk = 1.0E-06 for compounds with potency factor and 1 for compounds with reference dose.

TABLE B4

COMPARISON OF ACCEPTABLE STREAM CONCENTRATIONS
WITH STREAM CONCENTRATIONS BASED ON NATURAL DISCHARGE
OF SUBSURFACE WATER FROM THE TILL
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Compound	Acceptable Stream Concentration ¹ (ug/l)	Concentration at Unamed Ditch due to Discharge of Till Water at Acceptable Concentrations ² (ug/l)
Volatile Organic Compounds		
1,1-Dichloroethene	1.85	0.004
1,2-Dichloroethene(total)	2	0.039
Ethyl benzene	3,280	0.378
Methylene chloride	15.7	0.0026
Tetrachloroethene	8.85	0.0004
Toluene	3,400	1.11
1,1,1-Trichloroethane	5,280	0.11
1,1,2-Trichloroethane	41.8	0.0003
Trichloroethene	80.7	0.0028
Vinyl chloride	525	0.001
Base Neutral/Acid Organics		
Bis(2-ethylhexyl)phthalate	50,000	0.0014
Di-n-butyl phthalate	154,000	1.9
1,2-Dichlorobenzene	763	0.333
Diethyl phthalate	52,100	15.6
Napthalene	620	7.3
Phenol	570	0.78
Inorganics		
Arsenic	0.0175	0.028
Chromium	11	0.028
Lead	10	0.028
Nickel	100	0.08
Zinc	47	3.9
Cyanide	5.2	0.09

Notes:

¹ From Table 1 of the Record of Decision (ROD) for the site, September 25, 1987 (or calculated on the same basis). Only those compounds detected in ECC soil samples are listed in this table.

² Assuming a dilution of 1:1800 for natural discharge of till water at acceptable concentrations into Unamed Ditch (from ECC Remedial Investigation, Appendix C).

TABLE B5

**ACCEPTABLE SOIL CONCENTRATIONS BASED ON SOIL INGESTION
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA**

Compound ¹	Potency Factor ² 1/(mg/kg/d)	Reference Dose ² (mg/kg/d)	Acceptable Soil Concentrations Based on Soil Ingestion ³ (ug/kg)	Range of Acceptable Soil Concentrations Based on Soil Ingestion ⁴ (ug/kg)
Volatile Organic Compounds				
Acetone		0.1	8,500,000	- 8,500,000
1,1-Dichloroethene	0.6		1,167	1,167 - 116,667
1,2-Dichloroethene(total)		0.009	765,000	- 765,000
Ethyl benzene		0.1	8,500,000	- 8,500,000
Methylene chloride	0.0075		93,333	93,333 - 9,333,333
Methyl ethyl ketone		0.05	4,250,000	- 4,250,000
Methyl isobutyl ketone		0.05	4,250,000	- 4,250,000
Tetrachloroethene	0.051		13,725	13,725 - 1,372,549
Toluene		0.3	25,500,000	- 25,500,000
1,1,1-Trichloroethane		0.09	7,650,000	- 7,650,000
1,1,2-Trichloroethane	0.057		12,281	12,281 - 1,228,070
Trichloroethene	0.011		63,636	63,636 - 6,363,636
Vinyl chloride	1.9		368	368 - 36,842
Total Xylenes		2	170,000,000	- 170,000,000
Base Neutral/Acid Organics				
bis(2-ethylhexyl)phthalate	0.014		50,000	50,000 - 5,000,000
Di-n-butyl phthalate		0.1	8,500,000	- 8,500,000
1,2-Dichlorobenzene		0.09	7,650,000	- 7,650,000
Diethyl phthalate		0.8	68,000,000	- 68,000,000
Isophorone	0.0041		170,732	170,732 - 17,073,171
Naphthalene		0.4	34,000,000	- 34,000,000
Phenol		0.04	3,400,000	- 3,400,000

Notes:

¹ Only organic compounds without a regulatory limit in soils (USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761) are shown.

² From USEPA Toxics Integration Branch, OERR, Washington, D.C. December 19, 1988, "Corrections to the July 1988 Update of the Characterization Tables in the Superfund Public Health Evaluation Manual."

³ Intake for compounds with potency factor: 0.1 g of soil/d by 70 kg resident adults. Intake for compounds with reference dose: 0.2 g of soil/d by 17 kg resident children. Acceptable risks: 1.0E-06 for compounds with potency factor; 1 for compounds with reference dose.

⁴ Range shown is for carcinogenic risks of 1.0E-06 to 1.0E-04 for compounds with potency factor. The value shown for compounds without potency factor is for a noncarcinogenic hazard index of 1.

TABLE B6

**ACCEPTABLE SOIL CONCENTRATIONS BASED ON THEORETICAL
SUBSURFACE WATER INGESTION AT THE SITE (10⁻⁶ RISK)
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA**

Compound ¹	Solubility ² (ug/L)	K _{oc} ³ (L/kg)	K _d ⁴ (L/kg)	Acceptable Subsurface Water Concentration ⁵ (ug/L)	Acceptable Leachate Concentration ⁶ (ug/L)	Acceptable Soil Concentration Based on Water Ingestion ⁷ (ug/kg)
Volatile Organic Compounds						
Acetone	1,000,000	0.372	0.003	3,500 RB	686,275	2,196
1,1-Dichloroethene	2,250,000	64.6	0.556	7 MCL	1,372	762
1,2-Dichloroethene(total)	700,000	49	0.421	70 MCL	13,720	5,782
Ethyl benzene	152,000	181	1.56	680 MCL	133,280	207,464
Methylene chloride	20,000,000	16	0.138	4.7 RB	915	126
Methyl ethyl ketone	268,000,000	1.23	0.011	170 LDWHA ⁶	33,320	352
Methyl isobutyl ketone	17,000,000	6.17	0.053	1,750 RB	343,000	18,200
Tetrachloroethene	200,000	66.9	0.575	0.69 RB	135	77
Toluene	535,000	162	1.39	2,000 MCL	392,000	546,134
1,1,1-Trichloroethane	4,400,000	142	1.22	200 MCL	39,200	47,871
1,1,2-Trichloroethane	4,500,000	68.7	0.591	0.61 RB	120	71
Trichloroethene	1,100,000	96.3	0.828	5 MCL	980	812
Vinyl chloride	1,100,000	2.45	0.021	2 MCL	392	8.3
Total Xylenes	198,000	332	2.86	10,000 MCL	1,960,000	5,596,192
Base Neutral/Acid Organics						
bis(2-Ethylhexyl)phthalate	1,300	100,000	860	2.50 RB	490	421,400
Di-n-butyl phthalate	13,000	1380	11.9	3,500 RB	686,000	8,141,448
1,2-Dichlorobenzene	145,000	366	3.15	600 MCL	117,600	370,158
Diethyl phthalate	4,320,000	69.2	0.595	28,000 RB	5,488,000	3,266,019
Isophorone	12,000	30.9	0.266	8.5 RB	1,673	445
Naphthalene	30,000	1,280	11.0	14,000 RB	2,744,000	30,205,952
Phenol	93,000,000	21.9	0.188	1,400 RB	274,400	51,680

Notes:

¹ Only organic compounds without a regulatory limit in soils (USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761) are shown.

² From ECC Remedial Investigation, Table 5-3, and Verschuere, 1983, "Handbook of Environmental Data on Organic Chemicals."

³ From Indiana Department of Environmental Management's "Resource Guide, Voluntary Remediation Program", October 1995, the USEPA's "Technical Background Document for Draft Soil Screening Framework," December 1994, and Exhibit A-1 of the USEPA's "Superfund Public Health Evaluation Manual," 1986.

⁴ Calculated as the product of the organic carbon partition coefficient (K_{oc}) and the fraction of organic carbon (f_{oc}). The f_{oc} was calculated from the 95% lower confidence limit of the arithmetic mean total organic carbon concentration (i.e., 8,600 mg/kg) analyzed as part of the November 1995 Soils Total Organic Carbon Investigation.

⁵ RB = risk based concentration, from Table B3; MCL = Maximum Contaminant Level, from 40 CFR 141; and LDWHA = lifetime drinking water health advisory, from "Superfund Public Health Evaluation Manual," 1986. The MCLs (except for xylene) are those that existed at the time of the Record of Decision Issuance.

⁶ Leachate discharge/subsurface water discharge = 0.0051 (Appendix C of the ECC RI; and reduction of the 7.8 inches/year recharge used in the RI under current conditions (pages 5-8) by 99 percent due to the cap.)

⁷ Soil concentration (ug/kg) = K_d * Concentration in the leachate (ug/l).

TABLE B7

**ACCEPTABLE SOIL CONCENTRATIONS BASED ON THEORETICAL SUBSURFACE
WATER INGESTION AT THE SITE (RANGE OF RISKS)
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA**

Compound ¹	Range of Kd ²	Acceptable Soil Concentration Based on Water Ingestion ³	
		Range for 1.0E-04 Risk (ug/kg)	Range for 1.0E-06 Risk (ug/kg)
Volatile Organic Compounds			
Acetone	0.003 - 0.005	2,196 - 3,651	2,196 - 3,651 ⁴
1,1-Dichloroethene	0.556 - 0.924	762 - 1,267	762 - 1,267 ⁵
1,2-Dichloroethene(total)	0.421 - 0.701	5,782 - 9,614	5,782 - 9,614 ⁴
Ethyl benzene	1.6 - 2.6	207,464 - 344,969	207,464 - 344,969 ⁵
Methylene chloride	0.138 - 0.229	126 - 209	126 - 209 ⁵
Methyl ethyl ketone	0.011 - 0.018	352 - 586	352 - 586 ⁵
Methyl isobutyl ketone	0.053 - 0.088	18,200 - 30,263	18,200 - 30,263 ⁴
Tetrachloroethene	0.58 - 1.0	7,739 - 12,868	77 - 129
Toluene	1.39 - 2.32	546,134 - 908,107	546,134 - 908,107 ⁵
1,1,1-Trichloroethane	1.22 - 2.03	47,871 - 79,600	47,871 - 79,600 ⁵
1,1,2-Trichloroethane	0.59 - 0.98	7,111 - 11,823	71 - 118
Trichloroethene	0.83 - 1.38	812 - 1,350	812 - 1,350 ⁵
Vinyl chloride	0.021 - 0.035	8.3 - 14	8.3 - 14 ⁵
Total Xylenes	2.9 - 4.7	5,596,192 - 9,305,296	5,596,192 - 9,305,296 ⁵
Base Neutral/Acid Organics			
bis(2-ethylhexyl)phthalate	860 - 1,430	42,140,000 - 70,070,000	421,400 - 700,700
Di-n-butyl phthalate	12 - 20	8,141,448 - 13,537,524	8,141,448 - 13,537,524 ⁴
1,2-Dichlorobenzene	3.1 - 5.2	370,158 - 615,495	370,158 - 615,495 ⁵
Diethyl phthalate	0.6 - 1.0	3,266,019 - 5,430,705	3,266,019 - 5,430,705 ⁴
Isochorone	0.026 - 0.044	4,384 - 7,289	43,836 - 72,890
Naphthalene	11.01 - 18.3	30,205,952 - 50,226,176	30,205,952 - 50,226,176 ⁴
Phenol	0.188 - 0.313	51,680 - 85,934	51,680 - 85,934 ⁴

Notes:

¹ Only organic compounds without a regulatory limit in soils (USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761) are shown.

² For a range of organic carbon content of 8,600 to 14,300 mg/kg (i.e., the 95% lower confidence limit to 95% upper confidence limit of the arithmetic mean of the site total organic carbon analytical results.) Soil samples were collected for total organic carbon analysis in November 1995 and the results were reported in the January 1996 Soil Organic Carbon Technical Memorandum. Calculated as presented in Table B6.

³ Acceptable Soil Concentrations at the risk shown (for compounds with a potency factor) for a range of organic carbon content of 8,600 to 14,300 mg/kg. Calculated as presented in Table B6.

⁴ Acceptable Soil Concentration range does not change because the compound does not have a potency factor.

⁵ Acceptable Soil Concentration range does not change because the value is based on regulatory limits [drinking water Maximum Contaminant Level (MCL), proposed MCL Goal or lifetime health advisory].

TABLE B8
SOIL TOTAL ORGANIC CARBON RESULTS
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Boring No.	Sample No.	Northing ft	Easting ft	Sampled Interval					
				A (0'-2') mg/kg	B (2'-4') mg/kg	C (4'-6') mg/kg	D (6'-8') mg/kg	E (8'-10') mg/kg	Mean (2'-10') mg/kg
B100	EC-B1217	922,271	725,902	4,360	3,760	5,900	4,060	15,300	7,255
B101	EC-B1218	922,171	725,904	4,860	3,670	5,990	14,100	6,210	7,493
B102	EC-B1219	922,071	725,905	7,260	16,800	16,500	15,100	7,920	14,080
B103	EC-B1220	921,971	725,906	6,230	6,620	44,100	40,400	12,200	25,830
B104	EC-B1224	922,261	725,802	9,460	2,510	2,810	11,800	13,100	7,555
B105	EC-B1223	922,170	725,804	5,640	18,000	17,000	24,900	12,500	18,100
B106	EC-B1222	922,061	725,805	5,420	8,840	14,000	11,300	9,500	10,910
B107	EC-B1221	921,970	725,806	5,740	7,430	11,700	9,060	9,240	9,358
B108	EC-B1216	922,268	726,702	3,000	4,730	9,040	16,500	18,000	12,068
B109	EC-B1215	922,168	725,704	6,190	2,610	3,480	3,300	3,120	3,128
B110	EC-B1214	922,068	725,705	3,280	2,850	2,700	4,130	7,080	4,190
B111	EC-B1213	921,968	725,706	4,890	[No recovery]	5,630	2,430	4,360	4,140
B112	EC-B1226	921,934	725,929	8,740	17,300	5,970	8,040	8,240	9,888
B113	EC-B1227	921,834	725,930	10,300	5,460	14,900	8,260	19,000	11,905
B114	EC-B1225	921,932	725,829	12,200	6,970	19,300	16,900	12,000	13,793
B115	EC-B1228	921,832	725,830	12,300	25,100	21,500	22,900	24,700	23,550

TABLE B9
CHEMICAL PROPERTIES OF ORGANIC COMPOUNDS
DETECTED IN THE SOILS AT CONCENTRATIONS
ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Parameter	Solubility (ug/L)	Vapor Pressure (mm Hg)
Volatile Organic Compounds		
Acetone	1,000,000,000	270
1,1-Dichloroethene	2,250,000	600
1,2-Dichloroethene(total)	700,000	324
Ethyl benzene	152,000	7
Methylene chloride	20,000,000	362
Methyl ethyl ketone	268,000,000	77.5
Methyl isobutyl ketone	17,000,000	6
Tetrachloroethene	200,000	17.8
Toluene	535,000	28.1
1,1,1-Trichloroethane	4,400,000	123
1,1,2-Trichloroethane	4,500,000	30
Semivolatile Organic Compounds		
bis(2-Ethylhexyl)phthalate	1,300	0.0000002
1,2-Dichlorobenzene	145,000	1
Isophorone	12,000	0.38
Phenol	93,000,000	0.341
Pesticides/PCBs		
Aroclor-1260 ²	2.7	0.0000405

Note:

¹ Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

² Soil limit assumed for PCBs is 10,000 ug/kg (40 CFR Part 761.125, "Polychlorinated Biphenyls Spill Cleanup Policy Rule").

References:

U.S. EPA, "Superfund Public Health Evaluation Manual," 1986.

U.S. EPA, "Water-Related Environmental Fate of 129 Priority Pollutants," December 1979.

U.S. EPA, "Handbook of RCRA Ground-Water Monitoring Constituents, Chemical and Physical Properties (40 CFR 264, Appendix 9)," September 1992.

**TABLE B10
REFERENCES**

**ECC SUPERFUND SITE
ZIONSVILLE, INDIANA**

CH₂M-Hill, "Environmental Conservation and Chemical Corporation Feasibility Study," December, 1986.

CH₂M-Hill, "Environmental Conservation and Chemical Corporation Remedial Investigation," December, 1986.

USEPA, "Draft RCRA Facility Investigation Guidance," July 1987, OSWER Directive 9502.00-6C.

USEPA, "National Primary Drinking Water Regulations," 40 CFR 141, as amended by 53 FR 37408, September 26, 1988.

USEPA, "National Primary Drinking Water Regulations," 40 CFR 141, last amended by 59 FR 34320, July 1, 1994.

USEPA, "Polychlorinated Biphenyls Spill Cleanup Policy Rule," 40 CFR Part 761, published in the Federal Register on April 2, 1987.

USEPA, "Superfund Public Health Evaluation Manual," October, 1986, PB87-183125 with updates of November 16, 1987 and July 1988.

USEPA, Toxics Integration Branch, OERR, Washington, D.C., December 1988.
"Memorandum with Corrections to the July 1988 Update of the Risk Characterization Tables in the Superfund Public Health Evaluation Manual."

USEPA, Office of Solid Waste and Emergency Response, "Memorandum on Interim Final Guidance for Soil Ingestion Rates," January 27, 1989.

USEPA, Region V, "Explanation of Significant Difference for the Environmental Conservation and Chemical Corporation. Superfund Site, Zionsville, Indiana,".

USEPA, Region V, "Record of Decision for Environmental Conservation and Chemical Corporation, and Northside Sanitary Landfill, Zionsville, Indiana," September 25, 1987.

APPENDIX C ECC - VAPOR EXTRACTION MODEL

Venting (Version 2.0, Environmental Systems & Technologies, Inc.), a computer model for soil vapor extraction, was used to model vapor extraction from the soil at the ECC site. The program performs a mass balance on each chemical component in the system at discrete time steps. The program considers four phases: gas, solid, water, and nonaqueous liquid. The mass of each component in each of these four phases is calculated for each time step using thermodynamic laws for partitioning among the four

$$Z_i P = X_i P_i = \alpha_i Y_i P_i = C_i^g R T$$

phases. The phase mole fractions are related by the following equation:
Where:

Z_i	=	mole fraction of component i in the gas phase
X_i	=	mole fraction of component i in the nonaqueous liquid phase
Y_i	=	mole fraction of component i in the water phase
P	=	absolute total gas phase pressure
P_i	=	vapor pressure of component i at ambient temp
α_i	=	aqueous phase activity coefficient of component i
C_i^g	=	equilibrium molar gas phase concentration of component i
R	=	gas constant
T	=	temperature

The program uses the finite difference method to calculate the change in number of moles of each component in the four-phase system during a small time interval (i) and then recalculate over the next time interval (i + 1), using the reduced number of moles resulting from subtracting the change in number of moles calculated for interval i from the number of moles present in the system at the beginning of interval i.

The program runs for a user-defined number of time intervals. The output for each time interval includes a concentration of each component remaining in the soil. This concentration is compared to the acceptable soil concentration for each component, and the number of time steps extended until each component concentration in the soil is below the acceptable soil concentration.

Table C-1 shows the chemical data used to run the model. The compounds to be evaluated are those shown in Table 3-2, which are amenable to removal by vapor extraction. The maximum detected soil concentrations were taken from Section 4 of the ECC RI, while the chemical data are from USEPA, "Superfund Public Health Evaluation Manual," 1986.

Soil sample analytical results were analyzed by three-dimensional kriging using C Tech Development Corporation's Environmental Visualization System (EVS) software. EVS was used to calculate the total mass of volatile compounds to be extracted as cited in Appendix A. The results of this analysis indicate that the total mass of volatile compounds is 2,164 pounds distributed throughout a total volume 486,000 cubic feet of contaminated soil.

As there was significant variation of compound concentrations between soil samples at the site, a theoretical block size was chosen to assure that the model would account for cleanup of the highest concentrations of contaminants. This theoretical soil block is 10 ft x 10 ft x 2 ft deep and was assumed to contain all components of interest at their maximum detected concentrations (Table C-1). Furthermore, it was conservatively assumed that the air flow through the soil would only be 15% efficient in removing the organics. In effect, this represents a worst case estimate of the time required to remove the organics from the soils. The mass of this block was estimated as 10,200 kg, yielding a total mass of 130 kg of volatile components in this block.

The air flow rate was estimated as a fraction of the total air flow rate to be used at the site (500 SCFM), based on the length of extraction trench influencing the assumed soil block (10 ft) as a ratio of the total length of extraction trenches (3,800 ft). This represents an air flow rate of 37.26 liters per minute.

The results, summarized in Figure C1, show that essentially no VOCs will be present in the hypothetical soil element after 350 days of soil vapor extraction.

Actual large-scale soil vapor extraction systems have been operated with excellent removals of compounds such as tetrachloroethene, trichloroethene, 1,3-dichloropropene, methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylenes. Some published references are:

- Lisiecki, J.B., and F.C. Payne. "Enhanced Volatilization: Possibilities, Practicalities, and Performance." Presented at the Engineering Foundation Conference, Mercersburg, PA, August 7-12, 1988.
- Regalbuto, D.P., J.A. Barrera and J.B. Lisiecki. "In-Situ Removal of VOCs by means of Enhanced Volatilization." Proceedings of the Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, Houston, TX, November 9-11, 1988.
- Johnson, J.J., and R.J. Sterrett. "Analysis of In-Situ Soil Air Stripping Data." Proceedings of the 5th National Conference on Hazardous Wastes and Hazardous Materials, Las Vegas, NV, April 19-21, 1988.

A full-scale vapor extraction system (Lisiecki and Payne, 1988) was able to remove tetrachloroethene from 5,600,000 $\mu\text{g}/\text{kg}$ to 17 $\mu\text{g}/\text{kg}$, as found by soil sample analysis, in 280 days. Therefore, both theoretical models and actual results show that the required removals will be accomplished by vapor extraction.

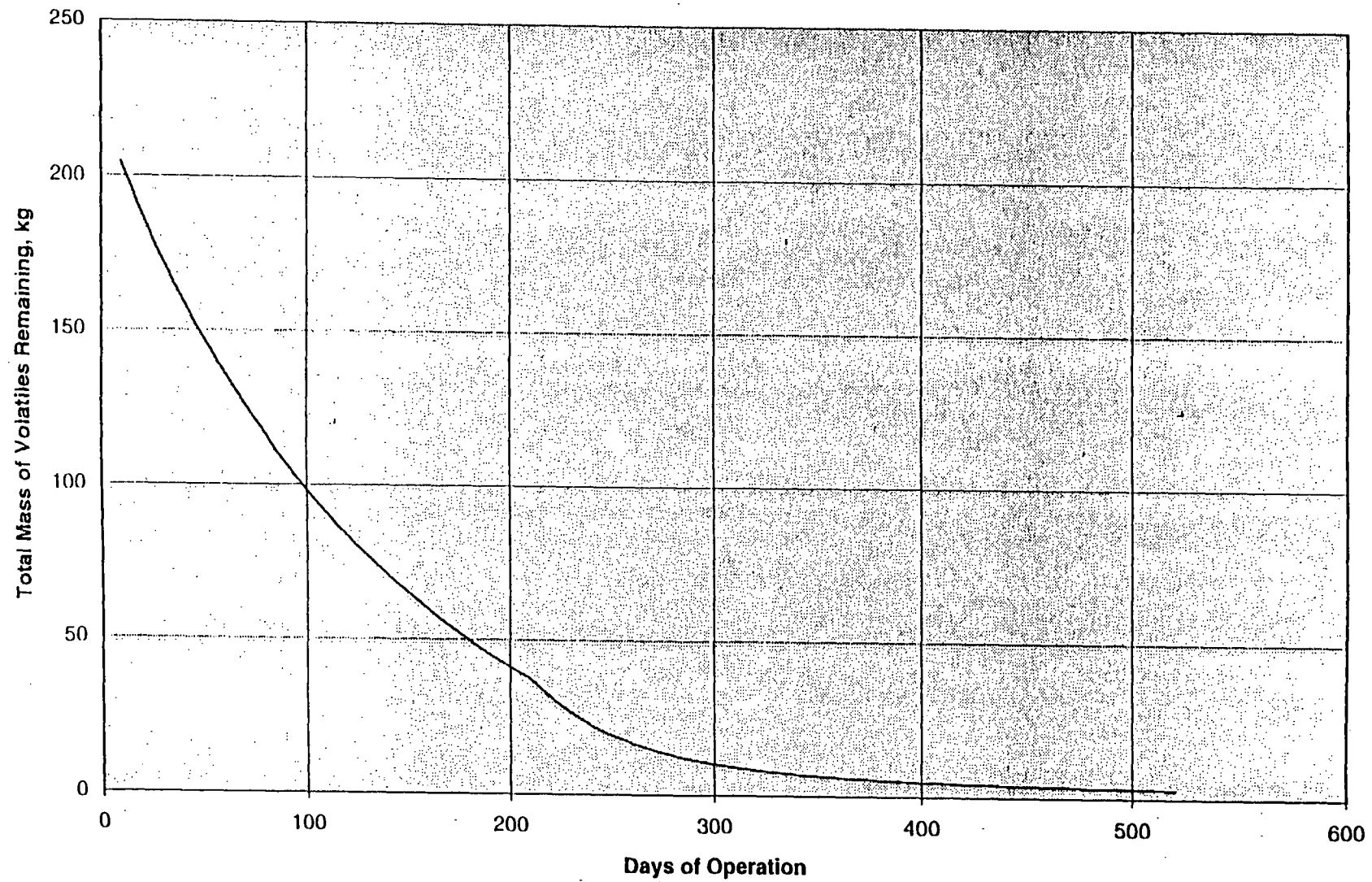
TABLE C1
COMPOUNDS DETECTED IN THE SOIL AT CONCENTRATIONS
ABOVE THE ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

Parameter	Molecular Weight (g/mole)	Vapor Pressure (atm)	Boiling Point (deg. C)	Solubility (mg/l)	K _{ow}	Maximum Detected Concentration (ug/kg)	Mass Fraction	Acceptable Soil Concentration (ug/kg)
Volatile Organic Compounds								
Acetone	58.1	0.355	56	1,000,000	0.58	650,000	0.030	2,196
1,1-Dichloroethene	97	0.789	37	2,250	70	35,000	0.002	762
1,2-Dichloroethene(total)	97	0.274	52	6,300	30	120,000	0.005	5,782
Ethyl benzene	106	0.00921	136.2	152	1,413	1,500,000	0.069	207,464
Methylene chloride	84.9	0.476	40	20,000	18	310,000	0.014	126
Methyl ethyl ketone	72.1	0.102	80	268,000	2	2,800,000	0.128	352
Methyl isobutyl ketone	100	0.0079	116.8	17,000	12	190,000	0.009	18,200
Tetrachloroethene	166	0.023	121	200	759	650,000	0.030	77
Toluene	92.1	0.037	111	535	490	2,000,000	0.092	546,134
1,1,1-Trichloroethane	133	0.162	74	4,400	148	1,100,000	0.050	47,871
1,1,2-Trichloroethane	133	0.0395		4,500	148	560.00	0.000	71
Trichloroethene	132	0.076	87	1,100	195	4,800,000	0.220	812
Total Xylenes	106	0.013	141.4	198	1,820	6,800,000	0.311	5,596,192
Base Neutral / Acid Organics								
1,2-Dichlorobenzene	147	0.0013	180.5	145	2,399	900,000	0.041	370,160

Notes:

¹ Compounds shown are those amenable to soil vapor extraction.

Figure C1
ECC Vapor Extraction Model Results



APPENDIX D CALCULATION OF SOIL VAPOR CONCENTRATIONS

The methodology to determine the soil vapor concentrations in equilibrium with Acceptable Soil Concentrations in Table 3-1 is presented below.

The soil vapor concentration of a chemical in equilibrium with the concentration on the soil particles is a function of the soil-to-water partition coefficient and of the air-to-water partition coefficient [Lyman, W.J., W.F. Reehl and D.H. Rosenblatt, *Handbook of Chemical Property Estimation Methods*, McGraw-Hill, Inc., 1982].

Since not all soil moisture will be evaporated during operation of the vapor extraction system (the soil's hygroscopic water will not be removed by the anticipated operating pressures), a relationship between soil vapor and soil moisture concentrations for the site's soils can be expressed as [Ibid] =

$$C_{sv} = H \cdot C_{sm}$$

Where:

C_{sv}	=	concentration of compound in soil vapor, mg/l
H	=	Henry's Law Coefficient (nondimensional)
	=	$\frac{V_p \cdot MW}{S \cdot R \cdot T}$
V_p	=	vapor pressure of compound, mm Hg
MW	=	molecular weight of the compound, g/gmole
S	=	solubility of the compound, g/cm ³
R	=	gas law constant = 62,361 mm Hg · cm ³ /gmole-°K
T	=	soil temperature = 283°K
C_{sm}	=	concentration of compound in soil moisture, mg/l

Similarly, the concentration in soil moisture in equilibrium with the concentration in soil particles can be calculated as [Ibid] =

$$C_{sm} = \frac{C_{sp}}{K_d}$$

Where:

C_{sp} = concentration of compound in soil samples, mg/kg
 K_d = soil-water partition coefficient, l/kg
[from Appendix B, Table B6]

Combining the two equations, a relationship between soil vapor and soil samples concentration is obtained [Silka, L.R., *Simulation of the Movement of Volatile Organic Vapor Through the Unsaturated Zone as it Pertains to Soil-Gas Surveys*, "Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water, 1986, p.204] =

$$C_{sv} = C_{sp} \cdot \frac{H}{K_d}$$

Table D1 presents the data and calculations of the soil vapor concentration in equilibrium with the Acceptable Soil Concentrations in Table 3-1. None of the results shown in Table D1 is above the corresponding vapor saturation concentration, the concentration in vapor in equilibrium with the pure compound. The vapor saturation concentrations for the compounds in Table D1, assuming each compound is present by itself in the soil vapor (i.e., molar fraction is equal to 1), are shown in Table D2. The vapor saturation concentration is calculated as:

$$C_{sat} = \frac{V_p \cdot X \cdot MW}{R \cdot T} \times 10^6$$

Where:

C_{sat} = vapor saturation concentration, mg/l
 X = molar fraction of compound in vapor, assumed to be 1
 10^6 = factor to convert g/cm³ to mg/l

TABLE D1

SOIL VAPOR CONCENTRATIONS IN EQUILIBRIUM
WITH ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA

(Page 1 of 2)

Compound ²	Molecular Weight ³ (g/gmole)	Vapor Pressure ³ (mm Hg)	Solubility ³ (ug/l)	Henry's Law Constant ⁴ (dimensionless)	Soil-water Partition Coefficient ⁵ (l/kg)	Acceptable Soil Concentration ⁶ (ug/kg)	Soil Vapor Concentration ⁷	
							(mg/l)	(ppmv)
Volatile Organics (VOCs):								
Acetone	58.1	270	1,000,000,000	0.000889	0.003	2,196	0.61	244
1,1-Dichloroethene	97	600	2,250,000	1.47	0.556	762	2.0	481
1,2-Dichloroethene (total)	97	208	6,300,000	0.268	0.421	5,782	3.68	880
Ethylbenzene	106	7	152,000	0.277	1.56	207,464	37	8,076
Methylene chloride	84.9	362	20,000,000	0.0871	0.138	126	0.08	22
Methyl ethyl ketone	72.1	77.5	268,000,000	0.00118	0.011	352	0.04	13
Methyl isobutyl ketone	100	6	17,000,000	0.00200	0.053	18,200	0.69	159
Tetrachloroethene	166	17.8	200,000	0.837	0.575	77	0.11	16
Toluene	92.1	28.1	535,000	0.274	1.39	546,134	107	27,090
1,1,1-Trichloroethane	133	123	4,400,000	0.211	1.22	47,871	8.3	1,442
1,1,2-Trichloroethane	133	30	4,500,000	0.0502	0.591	71	0.01	1
Trichloroethene	132	57.9	1,100,000	0.394	0.828	812	0.39	68
Vinyl chloride	63	2,660	2,670,000	3.35	0.188	8.3	0.15	54
Total Xylenes	106	10	198,000	0.303	2.86	5,596,192	595	130,244
Base Neutral/Acid Organic:								
1,2-Dichlorobenzene	147	1	100,000	0.0789	3.15	370,158	9.28	1,466
Phenol	94.1	0.341	93,000,000	0.0000196	0.188	51,680	0.005	1

TABLE D1

**SOIL VAPOR CONCENTRATIONS IN EQUILIBRIUM
WITH ACCEPTABLE SOIL CONCENTRATIONS¹
ENVIROCHEM SUPERFUND SITE
ZIONSVILLE, INDIANA
(Page 2 of 2)**

Notes:

¹ Acceptable Soil Concentrations are determined in accordance with Footnotes 5 and 6 of Table 3-1.

² Compounds above Acceptable Soil Concentrations in Table 3-1 to be removed by vapor extraction.

³ Data from USEPA, "Superfund Public Health Evaluation Manual." 1986.

⁴ Henry's Law Constant was calculated as:

$$\frac{(\text{Vapor pressure, mmHg}) * (\text{Molecular Weight, g/gmole}) * (1,000,000 \text{ ug/g}) * (1,000 \text{ cm}^3/\text{l})}{(\text{Solubility, ug/l}) * (\text{Ideal Gas Constant, } 62,361 \text{ mmHg-cm}^3/\text{mol-K}) * (\text{Soil temperature, 283 K})}$$

⁵ From Appendix B, Table B6.

⁶ From Table 3-1.

⁷ Concentration in soil vapor (mg/l) calculated as:

$$\frac{(\text{Concentration in soil, ug/kg}) * (\text{Henry's Law Constant, nondimensional})}{(\text{Partition Coefficient, l/kg}) * (1,000 \text{ ug/mg})}$$

Concentration in soil vapor (ppmv) calculated as:

$$(\text{Concentration in soil vapor, mg/l}) * (1000 \text{ l/m}^3) / (\text{Factor mg/m}^3/\text{ppmv})$$

Factors for conversion of mg/m³ to parts per million by volume (ppmv) were calculated in accordance with Vershueren, K. "Handbook of Environmental Data on Organic Chemicals," Second Edition, 1983 as follows:

$$\text{mg/m}^3/\text{ppmv} = \frac{(\text{Molecular weight, g/mol}) * (1,000 \text{ l/m}^3) * (1,000 \text{ mg/g}) * (1 \text{ atm})}{(\text{Ideal Gas Constant, } 0.08205 \text{ l-atm/mol K}) * (\text{Temperature, 283 K}) * 1.0E06}$$

TABLE D2

CALCULATION OF VAPOR SATURATION CONCENTRATIONS
 ENVIROCHEM SUPERFUND SITE
 ZIONSVILLE, INDIANA

Compound ¹	Vapor Pressure ² (mm Hg)	Molecular Weight ² (g/gmole)	Vapor Saturation Concentration ³ (mg/L)
Volatile Organics (VOCs):			
Acetone	270	58.1	888.9
1,1-Dichloroethene	600	97	3,297.8
1,2-Dichloroethene (total)	208	97	1,143
Ethylbenzene	7	106	42.0
Methylene chloride	362	84.9	1,741.5
Methyl ethyl ketone	77.5	72.1	316.6
Methyl isobutyl ketone	6	100	34.0
Tetrachloroethene	17.8	166	167.4
Toluene	28.1	92.1	146.6
1,1,1-Trichloroethane	123	133	927.0
1,1,2-Trichloroethane	30	133	226.1
Trichloroethene	57.9	132	433.1
Vinyl chloride	2,660	63	9,496
Total Xylenes	10	106	60.1
Base Neutral/Acid Organic:			
1,2-Dichlorobenzene	1	147	8.3
Phenol	0.341	94.1	1.8

Notes:

¹ Compounds above Acceptable Soil Concentrations in Table 3-1 to be removed by vapor extraction.

² Data from U.S. EPA, "Superfund Public Health Evaluation Manual," 1986.

³ Calculated as:

$$C_{sat} = \frac{V_p \cdot X \cdot MW \cdot 1.0E06}{R \cdot T}$$

Where:

- C_{sat} = Vapor saturation concentration, mg/L
- V_p = Vapor pressure, mm Hg
- X = Molar fraction of compound in vapor, assumed to be 1
- 1.0E06 = Factor to convert g/cm³ to mg/L
- MW = Molecular weight of the compound, g/gmole
- R = Gas law constant, 62,361 mm Hg-cm³/gmole-K
- T = Soil temperature, 283 K

SCHEDULE Z

SCHEDULE FOR IMPLEMENTING THE REMEDY ECC SUPERFUND SITE ZIONSVILLE, INDIANA

1.	Send out prequalification package to bidders	Ten days after later of: (a) receipt of U.S. Environmental Protection Agency's (USEPA's) comments on the 90% Design, (b) agreement on Revised Exhibit A, or (c) written agreement among the parties resolving all issues subject to dispute resolution
2.	(a) Submit final (100%) design to USEPA, Indiana Department of Environmental Management (IDEM) (b) Send out final bid package (c) Deadline for submission of bids (d) Preselection conference get USEPA's conceptual level concurrence of proposed Soil Vapor Extraction (SVE) methodology	Six weeks after the date specified in 1 above Two weeks after USEPA approval of 100% design Six weeks after USEPA approval of 100% design Ten weeks after USEPA approval of 100% design
3.	Submit SVE system design for "second look" review by USEPA	Later of: (a) 4 months after USEPA approval of 100% design, or (b) 2 months after USEPA conceptual level concurrence with SVE methodology
4.	Start remedy construction (mobilization on site) Dec. 2, 1997 ✓	Two weeks after USEPA approval of "Second Look" design; provided, however, that if USEPA has determined that a second Explanation of Significant Difference (ESD) is required before construction can begin, USEPA will notify the Settling Defendants prior to its approval of the "Second Look" design and approval of the "Second Look" design will not take effect for purposes of this schedule until the Settling Defendants receive additional notice from USEPA that the second ESD has become final.
5.	Complete installation of on-site and off-site monitoring wells (May 1998) →	Five months after date specified in Paragraph 4, above.
6.	Install Stage 1 cover and start up SVE system (Dec. 1998) →	Twelve months after date specified in Paragraph 4, above.
7.	Complete cap installation (Sept. 2004) →	Five years plus 9 months after the date specified in Paragraph 6, above, unless soil clean up of the entire portion of the site that is subject to SVE is verified pursuant to Sec. 4.2 of Exhibit A prior to that time, in which case cap installation will be completed within 9 months after soil clean up has been verified.
8.	Submission of all documents necessary to perform additional work if required under Section VII of this Decree	Six months after written notice is provided by USEPA or Settling Defendants that additional work needs to be implemented under Article VII.
9.	Complete installation of the subsurface water collection trench	On a schedule to be approved by USEPA after consultation with the State and the Settling Defendants.

- SVE start up date was Nov. 25, 1998
- Cap (stage 1) completed Nov. 11, 1998 (HDPE liner went down)

APPENDIX F
SIDEWALL SOIL SAMPLING PROTOCOL

SIDEWALL SOIL SAMPLING PROTOCOL

***ENVIRO-CHEM SUPERFUND SITE
ZIONSVILLE, INDIANA***

April 28, 1997

1.0 Introduction

On March 4, 1997, the Trustees confirmed that if exit soil sampling shows that the sidewalls of the southern pad excavation are contaminated above Indiana Department of Environmental Management (IDEM) RCRA clean closure criteria, the Trustees will excavate such contamination to the extent practicable. If in the judgment of the Trustees, such contamination cannot be practicably excavated in its entirety, then the lateral extent of unexcavated sidewall contamination will be determined. The goal of the sidewall sampling plan is to determine the extent of contamination and to then remove all contaminated soil that exceeds RCRA clean closure criteria unless it is impracticable to do so. All efforts consistent with this sidewall sampling protocol will be made to, at a minimum, excavate all contaminated soil which is above Exhibit A, Table 3-1 cleanup standards. A summary of the criteria and procedures that will be used by the Trustees is provided below:

Excavation and/or Delineation of Sidewall Contamination Implementation Summary

1. **Ninety days** prior to the commencement of excavation in the southern concrete pad area, the Trustees shall submit to EPA and IDEM a summary of the current IDEM RCRA clean closure criteria as applied to the ECC Site.
2. **Sampling and analysis by Trustees:** Prior to commencement of excavation in the southern concrete pad area, either a field gas chromatograph (GC) will be set up and calibrated by a qualified operator in a dedicated trailer, or arrangements will be made with a laboratory local to the Indianapolis area for 24 hour (or better) turn around. Calibration curves will be prepared for the Volatile Organic Compounds (VOCs) in Table 3-1, with detection limits less than the corresponding IDEM RCRA clean closure. The Field GC analysis if applicable, will be conducted in accordance with EPA Method 8021 to achieve Level 3 Data Quality Objectives (DQOs). If a field GC is to be used, a supplement to the QAPP for the field GC activities will be provided no less than 60 days prior to the start of excavation of the southern concrete pad area.

3. Sampling and analysis by U.S. EPA Side wall samples for cleanup verification will be collected by EPA at the locations specified by EPA/IDEM as described in the revised Exhibit A. The EPA, will use OVA or HNP results to assist in identifying where to collect sidewall and floor samples. The EPA will also evaluate the use of field GC results as screening tool prior to collecting samples for cleanup verification. All confirmatory sidewall samples collected by the EPA will be sent to an offsite laboratory for analysis. The sample locations will be documented by EPA and will be provided for field GC analysis to the Trustees via a chain-of-custody sheet. If a field GC is used by the Trustees, sufficient sample will be provided to the Trustees by EPA for both the Trustees field GC analysis and any confirmatory laboratory analysis called for by the Trustees field GC QAPP supplement.
4. The results of the sidewall sampling and analysis will be compared to the soil cleanup criteria in Table 3-1 and the RCRA clean closure criteria described in Paragraph 1 above.
5. In the area of the excavation where sheetpiling is not required (the western and southern portions of the excavation):
 - 5.1 If visible contamination is present in the sidewalls to the west or south, or the sidewall soil sampling results from the west or south side walls exceed the Table 3-1 soil cleanup values, every reasonable effort will be made to extend the excavation to the south or west as appropriate to assure that soils that are visibly contaminated or in excess of the Table 3-1 values are excavated within the limits of safety and practicability. If those sidewall sampling results are below Table 3-1 soil cleanup values but are above the RCRA clean closure criteria referred to in Section 1. above, those soils will also be excavated to the extent that it is practicable and cost effective in that the cost of such excavation exceeds the cost to extend a cap to this area. Although the final decision as to the extent of additional excavation will be made by the Trustees' Engineer in the field, he will consult with EPA and IDEM representatives before he makes the decision to close the excavation in accordance with the revised Exhibit A.

- 5.2 Once the additional excavation, if any, as described in Section 5.1 is complete, exit sampling shall be conducted. If the sidewall exit sampling data is below the RCRA clean closure criteria referred to in Section 1. above, then no further action will be conducted in that area. If sidewall exit sampling data is above these RCRA clean closure criteria, then a RCRA compliant cover (in accordance with Exhibit A) will be installed when the final cap is installed as and to the extent provided in Subsection 5.3 - 5.5 below.
- 5.3 Shortly before the installation of any final cap in the southern concrete pad area, the then current IDEM RCRA clean closure criteria will be established for this site using the then current IDEM RCRA clean- closure regulations and guidance.
- 5.4 Before installation of any final cap, the vertical and lateral extent of residual contamination above RCRA clean closure criteria that was not excavated (if any) will be determined by soil sampling. A soil sampling plan for the purpose will be submitted to EPA and IDEM for review and approval. This plan will be submitted to EPA and IDEM for review and approval at six months prior to beginning installation of RCRA cap.
- 5.5 A RCRA compliant cap will be installed over the area where the sampling conducted under Subsection 5.4 shows values in excess of the then current RCRA clean closure criteria. Any RCRA compliant cap that is required under this Subsection 5.5, will be installed to be continuous with the cap over the concrete pad area, if such a cap is required based on a comparison of the excavation bottom sampling with the then current RCRA clean closure criteria.
6. In the area of the excavation where sheetpiling is required (the eastern portion of the excavation), the sampling and capping steps specified in 5.2 to 5.5 will be followed, if sidewall exit sampling data on the eastern sidewalls is above the RCRA clean closure criteria. The sheetpiling to be used shall have ports

distributed laterally and vertically to provide access for sidewall verification soil sampling.

7. The area for any additional action referred to in Paragraphs 1. through 6. above, will in no event extend from the current southern excavation (concrete pad) area further east than the top of the bank of Unnamed Ditch, further south than the road to Northside Landfill, or further west than the western fence bordering the support zone. Under no circumstance will the excavation be extended to the north.